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Co-operative Experiments with Copper Carbonate Dust and Other Substances for Smut Control in 1923.

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A paper giving the results of experiments carried on in 1922 was published in *Scientific Agriculture,* Volume III, pages 297-302, May 1923. A review of the chief literature up to that date was given in that paper. Mackie and Briggs (1) point out, in a valuable contribution to this subject, that copper carbonate was first used by Tubeuf in 1902, but the tests were not continued. They also conclude from the results of extensive and carefully controlled experiments that "Copper carbonate dust applied to the seed at the rate of two or more ounces to the bushel effectively controls bunt when the seed is not blackened with spores. For heavily bunted seed bluestone and formaldehyde solutions are more effective, but are liable to cause severe seed injury". Coons (2) recommends the use of copper carbonate dust for the control of bunt of wheat, but does not recommend it for other grains.

As was pointed out in the previous paper, there are many advantages in the dust treatment with copper carbonate over the wet treatment with formaldehyde. The grain can be treated in advance of seeding without injury. The seed germinates more promptly, and a more vigorous growth of the seedlings results than with seed treated with formaldehyde solutions. The latter solutions, under certain conditions, cause serious seed injury and always retard germination and early growth.

Through the co-operation of the Dominion Experimental Farms at Indian Head, Rosthern and Scott in Saskatchean and at Lacombe in Alberta, it was possible to carry out extensive experiments with a number of substances for the control of bunt in wheat and smut of hull-less oats (Liberty). All the seed used was treated at the Dominion Laboratory of Plant Pathology at Saskatoon and forwarded to the several stations. Seeding and other operations, including harvesting and threshing, were done by the Experiment Stations.

An outline of the experiments on the seed treatment of wheat follows:—

SEEDS: Badly smutted wheat (black with smut); mixed varieties obtained from the Dominion Grain Inspector at Fort William, Ontario. The same seed lot was used at all the stations.

Treatments and Method

(1) Formaldehyde solution, 1-320, seed dipped 5 minutes, drained, covered 1 hour. The formaldehyde was tested by the Chemical Department of the University of Saskatchewan, and made up to proper strength.

(2) Copper carbonate. A commercial form of copper carbonate (copper equivalent 18%) was used. This was supplied by the Corona Chemical Co. For all the dust treatments a small hand machine was used, and the seed was treated until thoroughly coated with the dust.

(3) Semesan. A .25% solution was used. Seed was soaked one hour in solution, then dried. (Semesan was supplied by E. I. DuPont de Nemours Company).

(4) Copper sulphate and calcium carbonate. Monohydrated copper sulphate mixed with an equal weight of calcium carbonate. This was applied at the same rate and by the same method as with copper carbonate dust.

(5) Sulphur dust. The sulphur was superfine, 95% passing through a 200 mesh to the inch screen. It was applied at the rate of 6 oz. per bushel.

(6) Chlorophol. A .3% solution was used. The seed was soaked one hour and then dried.

Check. No treatment.

Estimate of Smut: The amount of smut was estimated by taking 100 heads from ten different places in each plot, and the percentage based on the number of smutted heads present in the 1000 heads, except at Indian Head where the number of heads counted in each plot was 300. Where only a trace or no smut is reported the whole plot was carefully examined. All the counts were made by a member of the staff of the Dominion Laboratory at Saskatoon, except at Indian Head where the counts were made by the station staff.

Smut Present: In the wheat experiments the smut present was *Tilletia tritici* (Bjerk.) Wint. In the oat experiments it was *Ustilago levis* (L.&S.) Magn.

Size of Plots: All of the plots were one-fortieth of an acre, seeded in duplicate at all the stations.

Yield: This is given in bushels and pounds per acre.

Moisture: The moisture content of the soil at seeding time was abundant (except at Rosthern where the soil was rather dry).

The results of the experiments with wheat are given in Table No. 1.

Though the same seed lot was used at al the stations it will be seen from the tabl that the smut percentage in the check plot ranged from 4% at Indian Head to abou 45% at Scott and Lacombe. Moisture wa abundant at all the stations (except at Ros thern), so that other factors, such as soi temperature, were probably responsible fo this result.

All the treatments used gave good contro of smut, except sulphur dust at Lacombe It will be seen, however, that smut was no eliminated by any of the treatments excep by formaldehyde solution at the station where the checks showed a high percentag of smut. Where the percentage of smut wa low it was practically eliminated. Thus in seed black with smut and under condi tions favourable for the development o smut, copper carbonate dust did no eliminate smut, but where the condition were not favourable the control was prac tically complete. From these and previou experiments it is evident that dust treatmen with copper carbonate will be effective fo smut control when the seed is not ver heavily smutted.

Table No. 1 SEED TREATMENT FOR SMUT CONTROL, WHEAT.

		Date Seeded	Date Ripe	Percent Smut Present	Yield per acre bus.	lbs.
INDIAN HEAD:	Formalin	May 8	Aug. 30	0	13	30
	Copper carbonate	"	"	0	17	10
	Semesan	"	"	0	15	35
	Copper sulphate and calcium carbonate	"	"	0	16	15
	Sulphur dust	"	"	.3	16	20
	Chlorophol	"	"	.15	15	25
	Check	"	"	4.	12	25
LACOMBE:	Formalin	Apr. 28	Sept. 6	0	48	40
	Copper carbonate	"	"	1.	51	
	Sulphur Dust	"	"	7.3	47	40
	Check	"	"	46.	33	
ROSTHERN.	Formalin	May 3	Sept. 4	tr.	21	20
	Copper carbonate	"	"	tr.	22	20
	Semesan	"	"	tr.	26	
	Check	"	"	5.6	21	20
SCOTT:	Formalin	May 8	Sept. 4	tr.	45	30
	Copper Carbonate	"	"	.7	44	10
	Copper sulphate and calcium carbonate	"	"	.5	46	40
	Check	"	"	45.	25	40

Table No. 2. GERMINATION TESTS OF WHEAT

Used in Co-operative Experiments for Smut Control.

Tested immediately after treatment.

Treatments	No. of grains tested	Percentage Plates	Percentage Soil
Formalin	500	84.	22.7
Copper carbonate	500	91.1	75.9
Semesan	300	91.8	88.1
Copper sulphate, and calcium carbonate	300	93.1	75.
Sulphur dust	200	93.0	61.5
Chlorophol	200	93.0	89.7
Check	500	91.1	68.2

Table No. 3.

SEED TREATMENT FOR SMUT CONTROL, LIBERTY OATS (HULL-LESS).

		Percent germination 100 seeds Plate test	Soil test	Date seeded	Date ripe	Percent smut present	Yield in lbs.
	Formalin	88.5	33.5	May 8	Sept. 5	13.8	1075
	Copper carbonate	86.	69.	"	"	.8	1170
	Semesan	90.5	82.	"	"	.8	1285
INDIAN HEAD:	Copper sulphate & calcium carbonate	84.5	84.	"	"	.35	1305
	Sulphur dust	95.	72.5	"	"	.15	1285
	Chlorophol	94.5	88.	"	"	3.3	1250
	Check	94.5	71.5	"	"	20.1	1060
	Formalin	71.5	17.5	May 8	Sept. 4	1.6	2090
SCOTT:	Copper carbonate	75.	51.5	"	"	0	2200
	Check	87.5	57.	"	"	62.5	910
	Formalin	90.5	33.	May 9	Aug. 16	5.9	1620
ROSTHERN:	Copper carbonate	88.5	70.5	"	"	tr.	1860
	Semesan	91.	89.5	"	"	1.	1880
	Check	94.	70.5	"	"	22.	1680
	Formalin	88.5	16.5	Apr. 28	Aug. 20	1.9	2200
LACOMBE:	Copper carbonate	82.5	46.	"	" 19	tr.	2320
	Semesan	83.	74.5	"	" 18	tr.	2440
	Check	90.5	59.5	"	" 18	35.3	1720

The mixture of copper sulphate and calcium carbonate gave good control, but has not been tested extensively enough to recommend its use.

The experiments also indicate that semesan and chlorophol are effective, but both are wet treatments which require the soaking of seed for one hour, and this makes them troublesome for the treatment of grain in large quantities. (In last year's test chlorophol was not effective owing to the solution being too weak. This was due to an error in the directions sent with the chlorophol).

The yields in bushels per acre are given. While they are greater in the case of the dusts than in the formaldehyde treatment they are too close, however, to be of much significance.

There was severe injury in the field in the plots seeded with formaldehyde treated seed, much more than was usually found to occur. The other treatments gave no seed injury. Germination tests were made of the treated seed soon after drying. The results of these tests are given in table No. 2.

These results indicate that none of the treatments injured germination except formaldehyde solution. In the soil germination tests in the greenhouse it will be seen that in all cases, including the check, the germination percentage was reduced, probably from fungi in the soil used. This was very marked in the case of formaldehyde solution. The percentage of reduction in the semesan and chlorophol treatments was so small that it suggested these treatments deserve further tests as to their value in protecting against soil fungi.

Experiments were also carried out with hull-less oats (Liberty) for the control of smut. As formaldehyde solution of the strength commonly used injures germination, sometimes seriously, it is very desirable that a more satisfactory treatment be found. In all the experiments the formaldehyde treatment was modified by presoaking or by washing the grain after treatment, and by shortening the time of treatment. This resulted in less seed injury, but the smut was not satisfactorily controlled. The other treatments used were more satisfactory, but the best results were obtained with copper carbonate dust. It does not seriously injure the seed and if properly applied at the rate of 3 to 4 ounces per bushel will effectively control smut. In the experiments with hull-less oats the methods of treatment, size of plots, were similar to those described in the outline of experiments, except that the formaldehyde treatment was modified as described, and the seed lots were different at each station.

The results of the experiments are given in Table No. 3.

Experiments on a small scale were also carried out at the Dominion Laboratory of Plant Pathology at Indian Head and at Saskatoon with wheat. A number of dust and wet treatments were tried with the object of getting data, so that the most promising might be tested on a larger scale next season. The checks did not show a high percentage of smut so that the results are not as suggestive as was hoped. It would be very unwise to draw conclusions from experiments carried out on such a small scale for one season but they indicate that furfural and izal solutions of the strengths used, and under the conditions of the experiment, are not effective.

The seed lot was the same as that used in the cooperative experiments, and the methods of treatments, etc., were the same, or as indicated in the table of results. The plots at Indian Head were about 1-200 of an acre and at Saskatoon consisted of three rod rows.

The results are given in Table No. 4.

Experiments were also carried out with Liberty oats at the Dominion Laboratory plots at Indian Head and at Saskatoon, and in a general way the same results were obtained as in the co-operative experiments already described. They confirm the conclusion that copper carbonate dust is the most satisfactory treatment for hull-less oats. They also indicate that under the conditions of the experiment furfural and seed-o-san are not effective for smut control. The results are given in Table No. 5.

Table No. 4. SEED TREATMENT FOR SMUT CONTROL, WHEAT.

Plot No.	Treatment	INDIAN HEAD: $\frac{1}{200}$ acre plots Percent smut.	SASKATOON: 3 rod rows percent smut.
1	Formaldehyde, 1-320, dip 5 min. cover 1 hour, dry	0	0
2	Formaldehyde spray 1-1, rate 1 qt. to 50 bus.	0	tr.
3	Formaldehyde sprinkle, 1-320	0	0
4	Copper sulphate solution	0	0
5	Semesan, soaked 1 hour, .25% sol.	0	0
6	Chlorophol, soaked 1 hour, .3% sol.	0	0
7	610 Dust, corona, 2 oz. per bus.	0	0
8	620 Dust, corona, 2 oz. per bus.	0	0
9	Copper carbonate dust, 2 oz. per bus.	.16	0
10	Copper carbonate dust, 3 oz. per bus.	0	0
11	Copper carbonate dust, 4 oz. per bus.	0	0
12	Copper carbonate (pure) 3 oz. per bus.	0	0
13	Copper carbonate, 3 oz. per bus. on badly smutted grain	.16	0
14	Copper carbonate, 3 oz. per bus. (grain moderately smutted)	.16	0
15	Copper carbonate and infus. earth, 3 oz. per bus.	.5	0
16	Monohydrated copper sulphate, 3 oz. per bus.	0	0
17	Monohy. copper sulphate and calcium carbonate, 3 oz. per bus.	.16	0
18	Monohy. copper sulphate and calcium carbonate, 5 oz. per bus.	.16	0
19	Sulphur dust, superfine, 4 oz. per bus.	.66	0
20	Sulphur dust, superfine, 6 oz. per bus.	.83	0
21	Sulphur dust, superfine, 8 oz. per bus.	.16	0
22	Inoculated sulphur, 6 oz. per bus.	.5	tr.
23	Inoculated sulphur, 8 oz. per bus.	.16	0
24	Nickel carbonate, 3 oz. per bus.	.16	0
25	Monohydrated copper sulphate and lime, 3 oz. per bus.	.16	0
26	Seed-O-San, 1 oz. per bus.	.66	4.
27	Furfural, .08% solution, dip 5 mins. cover 1 hr.	5.5	1.6
28	Furfural, .16% sol. dip 5 mins. cover 1 hr.	3.8	1.8
29	Furfural, .15% sprinkle, cover 1 hour	3.8	.4
30	Furfural, .16% dip 5 mins. cover 1 hour	3.6	.8
31	Furfural, .5% solution, dip 5 mins. cover 1 hour	3.0	2.
31a	Izal, .15% solution, dip 5 min. cover I hour	1.3	1.6
32	Check. No treatment.	5.5	2.4

Table No. 5.
SEED TREATMENT FOR SMUT CONTROL, HULL-LESS OATS (LIBERTY)

Plot No.	Treatment	INDIAN HEAD: $\frac{1}{200}$ acre plots Percent smut.	SASKATOON: 3 rod rows Percent. smut
1	Formaldehyde, dip 5 mins. cover 30 mins. wash in water and dry	1	tr.
2	Chlorophol, soak 1 hour, .3% sol.	3.8	3.9
3	Copper carbonate, 3 oz. per bushel	1	tr.
4	Copper carbonate, 6 oz. per bus.	.1	0
5	Seed-O-San	30.3	21.2
6	Sulphur dust, 6 oz. per bus.	1.4	tr.
7	Sulphur dust, inoculated, 8 oz. per bus.	1.7	tr.
8	Monohy. copper sulphate and calcium carbonate, 4 oz. per bus.	4.1	tr.
9	Furfural, .08% solution, dip 5 mins. cover half hour	70.6	36.0
10	Furfural, .16% solution, dip 5 mins. cover half hour	73.6	36.2
11	Furfural, .04% solution, dip 5 mins. cover half hour	72.8	26.0
12	Check. No treatment	79.6	48.7

Table No. 6.

SEED TREATMENT FOR SMUT CONTROL, HULLED OATS (BANNER)

INDIAN HEAD—Size of Plots—$\frac{1}{200}$ acre.

Plot No.	Treatment	Percent Smut
1	Formaldehyde, 1-320, dip 5 min. cover 1 hour	0
2	Formaldehyde spray 1-1, 1 qt. to 50 bus.	0
3	Copper carbonate dust, 3 oz. per bus.	.4
4	Copper carbonate, 5 oz. per bus.	0
5	Chlorophol, .3% solution, soak 1 hour	.2
6	Semesan, .25% solution, soak 1 hour	.4
7	Monohydrated copper sulphate and calcium carbonate, 4 oz. per bus.	.8
8	Sulphur dust, 6 oz. per bus.	0
9	Inoculated sulphur dust, 6 oz. per bus.	0
10	Furfural, .125%, dip 5 mins. cover half hour	19.3
11	Furfural, .25% dip 5 mins. cover half hour	25.8
12	Check. No treatment	22.4

Table No. 7.

SEED TREATMENT FOR SMUT CONTROL, BARLEY (JUNIOR).

Laboratory Field, Indian Head. Size of plots—$\frac{1}{200}$ acre.

Plot No.	Treatment	Percent Smut
1	Formaldehyde solution 1-320, dip 5 mins. cover 1 hour	0
2	Copper carbonate dust, 3 oz. per bus.	2.
3	Chlorophol, .3% solution, soak 1 hour	1.4
4	Furfural, .25% solution, dip 5 mins. cover 1 hour	1.4
5	Check. No treatment.	6.6

Experiments were also carried out with hulled oats (Banner) at the Dominion Laboratory at Indian Head. The seed was artificially smutted. It will be noticed that most of the substances used gave good results, except solution of furfural.

Results with hulled grain artificially smutted are of little value as the conditions in which the smut is carried on the seed may not be similar in naturally smutted grain. The results of the experiments are given in Table No. 6.

Experiments were also tried with barley, the seed being obtained from a field showing a heavy infection of covered smut *Ustilago hordei* (Pers.) K.&S. in the previous season. The experiment was only on a small scale and the percentage of smut in the check was not high, so the results are of little significance. Only formaldehyde solution gave satisfactory control. The results are given in Table No. 7.

SUMMARY AND CONCLUSIONS

Copper carbonate dust has been found, in many countries, to give effective control of bunt or stinking smut of wheat when the seed is not very heavily smutted. The experiments carried out the last two seasons in Saskatchewan and Alberta indicate that the same results will be obtained with this dust under the conditions prevailing in the wheat growing districts of Western Canada. It is essential that each kernel be thoroughly covered by the dust. This can only be done satisfactorily by the use of a machine. A number of machines for dust treatment are now being placed on the market. The dust should

be used at the rate of two or three ounces per bushel. It does not injure germination even if used in larger quantities.

Monohydrated copper sulphate and calcium carbonate, in equal quantities in the form of a dust, also gave effective control of bunt in wheat, but this treatment has not been sufficiently tested to recommend its use.

Copper carbonate is the most effective treatment for hull-less oats. It does not injure the germination of the seed, and effectively controls smut. It should be applied with a machine at the rate of three or more ounces per bushel.

Sulphur did not always give effective control of bunt, but owing to its cheapness it seems worth further trial, as it may be of value where the seed is only slightly smutted.

Solutions of semesan and chlorophol gave good control, but the method of soaking is troublesome with large quantities of seed. The germination tests in soil indicate that these substances may be of value where the soil is infected with fungi. Further tests along this line are desirable.

(The writers wish to acknowledge the generous co-operation of the Superintendents and Cerealists of the Dominion Experimental Farms at Rosthern, Scott, Lacombe and Indian Head. Without their assistance the experiments could only have been carried out in a small scale. Special acknowledgment is due to the Superintendent of the Dominion Experimental Farm at Indian Head for providing the labour necessary for all the experiments at Indian Head).

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1. Mackie, W. W. and Briggs, F. N. Fungicidal dusts for the control of bunt. Calif. Agric. Exp. Sta. Bulletin 364. 1923.

2. Coons, G. H. Copper dust successful against stinking smut. Michigan Quarterly Bulletin, August 1923.

THE O.A.C. SEMI-CENTENNIAL

During the entire week of June 9th, 1924, the Ontario Agricultural College will celebrate the fiftieth anniversary of the opening of that institution in 1874. Numerous committees have been at work for the past three months, and the final programme will be mailed about May 20th to all ex-students and graduates of the O.A.C. The Canadian Society of Technical Agriculturists is holding its Annual Convention at the College during the same week.

The semi-centennial celebration is the first attempt at a large re-union of O.A.C. students. There have been numerous local and provincial gatherings at the College in the past, but the programme being arranged for the week of June 9th surpasses in every respect anything that has ever been attempted at any Canadian Institution. The Memorial Hall will be formally opened by Sir Arthur Currie on June 10th.

Mr. Lionel Stevenson, Director of Extension at the O.A.C., is in charge of all arrangements as Secretary of the semi-centennial committees. He is anxious to hear from any who are planning to attend especially those from distant points.

Some details of the C.S.T.A. programme are published on page 291 of this issue, and a final programme will be mailed to all members about May 15th.

Some Notes on the Semen of Bulls.*

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Breeders have long recognized that, aside from the question of prepotency, all bulls are not equally effective sires. Some have high fertility while others require an average of many services to produce one offspring. A few are sterile; others worse than sterile because by spreading venereal infections they partly or completely sterilize the females to which they are mated.

The need of some means for determining an animal's fertility, especially when purchase is contemplated, is quite obvious. For, without a full measure of that quality in a sire, pedigree, conformation, show ring history and other "selling points" are utterly irrelevant to the principal object for which the animal is kept, i.e. his ability to reproduce successfully.

Unfortunately the subject has not heretofore received the scientific attention which its importance merits. During the past twenty-five years veterinarians have had their attention so rivetted on abortion, particularly that associated with the Bang organism, that they have largely ignored every other kind of reproductive failure. Because also of the belief that the bull has little to do with the spread of "contagious abortion", many have erroneously assumed that all bulls are more or less equal in fertility. Recently, however, a decided change has taken place.

Four years ago Dr. Williams, Jr., published a detailed account (1) of some bulls he had studied, showing that there was great variation in the procreative ability of these animals. He also indicated how this might be ascertained and, in this connection, emphasized three things—(1) the animal's breeding history; (2) a thorough physical examination and (3) a proper study of the semen itself. A word on each of these.

The breeding history of an animal is a good general indication of its fertility and an abundance of vigorous offspring its best recommendation to the layman in this respect. Such history, however, is always nine months late at best, and is practically never complete. Non-productive services are seldom recorded: the condition of each calf for two weeks subsequent to parturition is not often known: the genital health of the mate on every occasion is usually a matter of presumption. Hence it is plain that this information alone cannot form an absolutely sound basis for determining the point in question.

Clinical examination, conducted by a person of experience, furnishes a very valuable supplement to the breeding record. Alone, it may even be more valuable. But in this matter, the personal element of the examiner is paramount, and it must be confessed that there are lamentably few veterinary surgeons capable of making a *thoroughly competent* examination of the genitalia of bulls. The animals may be very awkward patients to handle and calls for this kind of work almost unknown,—two statements which, while perhaps they explain the fact, do not alter it.

Deploring most so-called breeding records, particularly in herds where reproductive losses are high, and lacking a wide clinical experience with bulls, I have paid some attention during the past year to a study of the semen. Moreover, aside from the two reasons given, I have subscribed to the dogma that *if a male is sexually sound, his semen is sound.* I have also assumed the *converse* and the *reverse* of that statement to be true. In other words, unsound semen indicates a genitally unsound bull; normal semen a healthy one. Exactly what constitutes *soundness* and whether that can be determined by microscopic means alone, is a question to which the following is only a partial answer.

It is unnecessary to burden the reader with details concerning the manner in which material has been collected and prepared for study. Suffice to say that, except in the matter of staining, the general technique of Williams (Q.V.)

*Substance of a paper given before the Veterinary Association of Manitoba, February, 1924.

has been followed pretty closely. This involves manual recovery of the semen from a suitable female shortly after it has been deposited in the usual way. So far no absolutely satisfactory combination of stains has been found, spermatozoa being refractory subjects when considered with this object in view. The best single stain seems to be iron-alum haematoxylin used regressively. By employing cumbersome methods, striking contrasts can sometimes be had with the anilin dyes. They are impermanent, however, and often fade in a few days.

Normal semen, suitably prepared and seen under proper magnification, contains a great abundance of sperms and, practically little else (Figs 1 and 2). These sperms are remarkably uniform in size and shape. Each consists chiefly of a head, middle piece and tail. The head or "body" is oval, as usually observed, and contains a distinct nucleus that occupies from one-third to half of the cell at its basal end. Immediately behind the head, and of about the same length, is a narrow cylindrical middle piece: these two are united by a tiny constricted part sometimes referred to as the "neck". Continuous with the middle piece there follows a rather long, tapering and whip-like tail by the movements of which the sperm is propelled when alive. Some flat epithelial cells and a very few others may be present without arousing suspicion.

The abnormalities of semen, seen microscopically can be provisionally classified as follows:

(1) *Absence, defects* and *deformities* of elements normally present.

A. Absence of sperms (azospermie) (Case No. 2).

B. Imperfectly developed sperms, (spermatocytes, etc.)

C. Defects and deformities of sperms.

I. *Heads.*

a.–variations in size and shape: elongated, rounded, pyriform, (Cases 1 & 3), etc.

b.–defective staining: solidly stained, "phantoms", degenerate or ruptured nuclei, etc.

II. *Middle Pieces.*

absent, double, thickened, spheroidal swellings, etc. (Case 1).

III. *Tails.*

absent, double, coiled about head, etc. (Case 5).

(2) *Admixtures* of foreign elements.

These include various kinds of epithelial cells, blood, pus, fibrin, granules and unidentified bodies (Cases 2, 3, 4, 5.)

Many specimens show both defects and admixtures. The exact significance of these abnormalities, either individually or in combination, is anything but clear. Many of them are mutually exclusive.

A few selected cases, illustrating the occurrence of abnormal semen in relation to poor reproduction, are appended. It must not be thought that the bull alone was to blame in all instances because that would assume, with-

Fig. 1. A single normal sperm, X 900.

Fig. 2. Normal semen, X 500.

Fig. 3. from case 1. X 600. Tailless and misshappen heads: one swollen middle piece: some foreign matter.

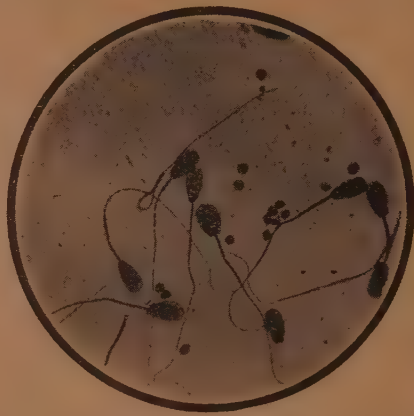

Fig. 4. from case 1. X 500. Variations in size and shape of heads: also some "unidentified bodies."

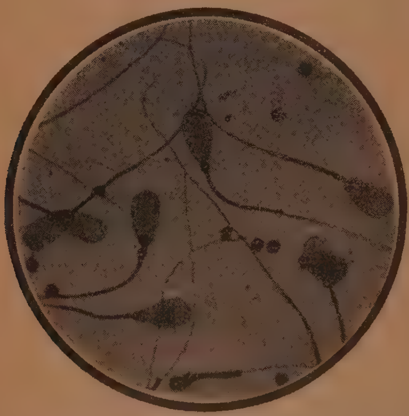

Fig. 5. from case 1. X 900. Two sperms clearly showing spheroidal swellings of the middle piece.

Fig. 6. from case 4. X 500. Wedge shaped heads, narrow at the base.

Fig. 7. from case 4. X 900. numerous "unidentified bodies."

out reason, that all the females were genitally faultless. Nor must the history of the herds mentioned be considered unusually vague for, as hinted above, most breeders keep abominably unsystematic records of the reproductive performance of their animals.

CASE 1. A vigorous Holstein bull now 3½ years old. During his first eighteen months in service he copulated 32 times *with genitally healthy females*. The result was 18 pregnancies (56%) two of which terminated by abortion, one by fatal dystochia and 15 by producing good calves. His net efficiency as a sire has been 47%. Clinically he is without fault.

Examination of his semen shows him to be a sort of spermatic clown. Fully one-third of the sperms are without tails: all of them stain poorly: many show a peculiar spheroidal swelling of the middle piece and there is wide variation in the size and shape of the heads. (see Figs. 3, 4, 5). It is not known whether he is infected with the Bang organism. Both his record and the microscope, however, show that he is spermatically unsound.

CASE 2. Another vigorous specimen of a young bull, of unknown previous history and newly purchased to head a dairy herd. The owner became suspicious because even his best females would not "settle" to this animal. Examination of the cows failed to reveal lesions to which so much sterility could be attributed.

Semen was obtained and sent here by the attending veterinary surgeon. It contained a wide variety of epithelial cells, some pus, and a lot of mucin but, so far as I could determine, there was not even a single sperm present.

The bull was killed so quickly as to preclude post-mortem study. Another now heads the herd and, from recent accounts, most of the females are pregnant.

CASE 3. This is a bull that had changed hands several times before getting into a herd that is pretty well saturated with genital infections. His actual performance cannot be found out but it is quite safe to say that it is poor.

Semen shows both defects and admixtures. Most of the sperms stain well but are narrow at the base. About 25% of them are tailless. Elongated, rounded and otherwise misshapen heads comprise nearly 10% of the total number. Many small round eosinophile bodies are present. The source of these I do not know at present: they may be degenerate spermatocytes.

CASE 4. This animal has an indefinitely bad record. The herd into which he was introduced had given the owner no special trouble until after he arrived. Since then about half his cows and heifers have visibly aborted, many required repeated services to be able to abort again and some have become sterile.

The principle defects seen in a sample from this bull are that about 20 to 25% of the heads are constricted at the base. Staining quality is not bad. Admixtures include many epithelial cells and large numbers of the unidentified bodies already noted in Case 3. Under high magnification these stand out impressively. (Fig. 6. 7).

CASE 5. This bull has incurred the suspicions of everyone associated with him. There is no accurate breeding history. The herd which he heads, however, has been numerically decreasing for a number of years and has had to be reinforced by continuous outside purchases. That fact considered with the observed abortion rate of about 10% per annum, speaks loudly for much sterility.

Preparation of his semen show poor staining quality in the sperms but a minority of aberrant heads. Some have two tails: there are others with that appendage coiled about the body in such a way as to make locomotion impossible. Foreign cells are abundant. There are also numerous refractile granules, large masses of bacteria (cocci) and considerable tissue detritus.

Not having examined the animal, I do not know what, if any lesions he possesses, but from the evidence at hand, am convinced that he is a genitally dangerous brute.

It would not be logical to attempt drawing definite conclusions from these sketchy observations. They lend support in a general way, however, to the old statement that *for the production of healthy young, it is necessary to mate genitally sound females to equally sound males.*

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Measurements of Carbon Dioxide Evolved from the Roots of Various Crop Plants.

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In an earlier paper (1) the author described a simple method for measuring the rates of evolution of CO_2 by the roots of growing plants, and reported the results of a few such measurements. Since writing the foregoing paper, a number of further measurements have been made with various crop plants, and the method has been extended to include simultaneous measurements of the rates of transpiration.

The object of measuring the rates at which CO_2 is evolved from the roots of different crop plants was, in the first place, to find if it would be possible, thereby, to offer an explanation for differences in the abilities of different plants to absorb calcium, phosphorus, and certain other elements from a given soil. It is known, for example, that certain legumes normally absorb and contain more calcium than certain non-legumes, and it was thought that these legumes might absorb more calcium, because they evolve more CO_2 from their roots and thereby bring more calcium into solution in the vicinity of their roots. The subject of CO_2 evolution by plant roots is, however, of interest from a number of standpoints.

The importance of the direct effect on photosynthesis of CO_2 from the soil has been discussed in many recent papers. For example, the CO_2 assimilation by the leaves of carrots and beans was found by Lundergardh (2) to vary proportionally to the CO_2 content of the air in cylinders in which they were grown. He considers that the concentration of CO_2 at the level of the assimilating leaves is controlled by the amount produced by the soil. Estimations of the CO_2 in the atmosphere immediately around the leaves of plants growing in manured fields showed that ordinary dressings of manure may cause as much as 28 per cent increase. There is some opposition to the view that CO_2 from the soil directly accelerates photosynthesis and growth, but Fischer (3) in a critical review of very recent contributions to th[e] subject, corroborates the claim, and point[s] out the need for a fuller knowledge regard[ing] the method of its employment.

The method of measuring simultaneousl[y] the rates of transpiration and of CO_2 evolu[tion] from the roots was as follows: One quart Mason jars were used, and a hole [a] little less than one-half inch in diameter wa[s] bored in the bottom of each, by a glass cutter, to provide for drainage. These hole[s] were then covered by a little glass wool, an[d] the jars were filled almost to the stopper with washed sand. One, or more, seedling[s] were planted in each jar, each plant passin[g] through a separate hole in the large rubbe[r] stopper. Through two other holes in th[e] stopper glass tubes were inserted just throug[h] the stopper from above. One was a straigh[t] glass tube through which nutrient solutio[n] could be poured, and the other was a larg[e] diameter, bent glass tube, the other end o[f] which was inserted in a flask of standar[d] barium hydrate whenever the CO_2 outpu[t] was to be determined. At these times th[e] open space in the stopper around the plan[t] was carefully filled with plastic clay, th[e] tube through which nutrient solution wa[s] added was closed, a small rubber stopper wa[s]

Plate 1—Flasks of barium hydrate connected w[ith] Mason jars for absorbing CO_2 evolved [from] roots of growing plants.

inserted in the bottom of the jar, and the CO_2 was absorbed by the standard barium hydrate (approximately .05 normal) for a period of 48 hours (or less). (See Plate 1.) The unprecipitated barium hydrate was then titrated with .05 normal hydrochloric acid, using phenolphthalein as the indicator. The rate of transpiration was measured either simultaneously or just after the CO_2 measurements were made. This was done by saturating the sand with nutrient solution and letting it drain through the bottom opening until it ceased to drip, then stoppering the jar and letting it stand for 48 hours, then saturating the sand a second time with a known volume of solution and measuring the valume draining off. The volume of solution required to saturate the sand the second time, minus the excess which drained off when the bottom stopper was removed was equal to the volume of water transpired in 48 hours (neglecting the small amount fixed by the plant in 48 hours' growth). Having set up each jar on a separate vessel in which to collect the drainage, it seemed more convenient to determine the rate of transpiration in this manner than by weighing the jars.

The results of a series of measurements on one lot of plants, for convenience designated Series A, are recorded in Table 1. This table is divided into four sections. Under (a) will be found the quantities of CO_2 evolved from the roots in 48 hours, in relation to the water transpired, when the plants were about 50 days old; under (b) the same measurements, when the plants were three weeks older; under (c) the weights of the plants when harvested, just after the rates of transpiration and CO_2 evolution had been measured for the second time, and under (d) the quantities of CO_2 evolved in 48 hours, in relation to the weights of the plants at the time of harvesting.

It should be explained that the vetch and buckwheat plants were injured by insects, and did not grow normally. This is reflected in their small weights at the time of harvesting. Results obtained with these plants, though somewhat irregular, are included in order to bring out the relationship between the quantities of CO_2 evolved from the roots, and of water transpired, for it will be noticed that these injured plants transpired little water and gave off little CO_2.

If we leave these injured plants, vetch and buckwheat out of consideration it will be observed (Table 1, (a) and (b)) that the total quantities of water transpired by the different plants in 48 hours varied from 28 to 158 cubic centimeters, and that the total quantities of CO_2 evolved by the different plants varied from 3.7 to 35.1 milligrams, but that the quantities of CO_2 evolved per cubic centimeter of water transpired varied only from .12 to .27 milligrams. Hence it will be realized that there is a reasonably close correlation between rates of CO_2 evolution from the roots and of transpiration. A number of investigators have maintained that there is a distinct relationship between the life activities of plants and the water transpired, and Turpin (4) points out that there is a relationship between the water transpired by the plant and the CO_2 content of the soil.

It will be noticed (Table 1, a and b) that nearly every plant gave off less CO_2 the second time measurements were made, although the plants were three weeks older, and presumably larger. Evidently they were in a less active state, because of difference in age or climatic conditions, when the second measurements were made. It would be interesting to determine the effect of temperature upon rates of CO_2 evolution from the roots and transpiration. In view of the changes in a plant's activity, caused by differences in age and climatic conditions, it appears useless to expect to find a close correlation between size of plant and quantity of CO_2 evolved. Naturally, however, increased size is frequently associated with increased growth and transpiration, and, as previously stated, there appears to be a reasonably close relationship between rates of CO_2 evolution from the roots and transpiration. By determining the quantities of CO_2 given off at a number of stages of growth, and under comparable conditions, it may be possible to derive a curve, for each plant, from which may be calculated the total quantity of CO_2 given off by the roots during the whole period of growth. It may then be found that there are important differences in the quantities evolved by different crop plants in relation to the weight of dry matter produced.

Table 1—CO_2 EVOLVED FROM ROOTS IN RELATION TO TRANSPIRATION AND WEIGHT OF PLANTS.
Experimental Series A.

	Barley	Barley	Wheat	Wheat	Rape	Rape	Pea	Pea	Vetch	Vetch	Buckwheat	Buckwheat
	(a) CO_2 Evolution in relation to transpiration—First Test.											
Water transpired in 48 hours, Nov. 17 Nov. 19, 1923	90 cc.	98 cc	96 cc.	98 cc.	130 cc,	132 cc.	35 cc.	38 cc.	11 cc.	25 cc.	22 cc.	32 cc.
CO_2 evolved from roots in 48 hours, Nov.15, Nov.17, 1923	23.7mgm.	13.5mgm.	20.9mgm.	24.2mgm.	35.1mgm.	28.1mgm.	5.5mgm.	6.0mgm.	1.8mgm.	4.5mgm.	6.8mgm.	8.8mgm.
CO_2 evolved from roots per c.c. water transpired	0.26 "	0.14 "	0.22 "	0.25 "	0.27 "	0.21 "	0.16 "	0.16 "	0.16 "	0.18 "	0.31 "	0.28 "
	(b) CO_2 Evolution in relation to transpiration—Second Test.											
Water transpired in 48 hours, Dec. 8, Dec. 10, 1923	121 cc.	127 cc.	123 cc.	123 cc.	144 cc.	158 cc.	28 cc.	37 cc.	6 cc	16 cc.	4 cc.	5 cc.
CO_2 evolved from roots in 48 hours Dec. 6, Dec. 8, 1923	15.1mgm.	18.0mgm.	18.4mgm.	20.6mgm.	24.4mgm.	24.1mgm.	3.7mgm.	4.8mgm.	1.5mgm.	3.0mgm	4.0mgm.	4.3mgm.
CO_2 evolved from roots per c.c. water transpired	0.12 "	0.14 "	0.15 "	0.17 "	0.17 "	0.15 "	0.13 "	0.13 "	0.26 "	0.19 "	0.99 "	0.86 "
	(c) Weights of plants when harvested.											
Plants 78 days old, Harvested Dec. 11, 1923												
No. of Plants	1	1	1	1	1	1	1	1	1	1	1	1
Tops green	33.1mgm.	35.2mgm.	29.6mgm.	25.2mgm.	74.2mgm.	66.4mgm.	6.5mgm.	9.95mgm.	.4mgm.	1.35mgm.	1.08mgm.	2.4mgm.
Roots wet	12.2 "	9.4 "	10.7 "	14.0 "	12.5 "	13.6 "	2.8 "	3.2 "	.65 "	2.4 "	.41 "	1.85 "
Tops dry	4.27 "	4.21 "	4.5 "	4.17 "	6.53 "	5.95 "	1.78 "	2.53 "	.32 "	.65 "	.37 "	.95 "
Roots dry	2.51 "	2.37 "	1.34 "	1.77 "	2.31 "	2.39 "	.45 "	.72 "	.16 "	.52 "	.26 "	.54 "
Total dry	6.78 "	6.58 "	5.84 "	5.94 "	8.84 "	8.34 "	2.23 "	3.25 "	.48 "	1.17 "	.63 "	1.49 "
	(d) CO_2 Evolution, just before harvesting, in relation to weights of plants.											
CO_2 evolved from roots in 48 hours, Dec. 6, Dec. 8, 1923	15.1mgm.	18.0mgm.	18.4mgm.	20.6mgm.	24.4mgm.	24.1mgm.	3.7mgm.	4.8mgm.				
CO_2 evolved from roots in 48 hours, per gm. d.m. of roots	6.0 "	7.6 "	13.7 "	11.6 "	10.6 "	10.1 "	8.2 "	6.7 "				
CO_2 evolved from roots in 48 hours, per gm.	[illegible]	[illegible]	[illegible]	[illegible]	2.8 "	2.9 "	1.7 "	1.5 "				

It would also be interesting to compare the rates of CO_2 evolution from the roots and transpiration when the plants are absorbing from different salt solutions. The rate of CO_2 evolution may be a measure of the energy which the plant root expends in absorbing from the solution in which it is growing. This is suggested by the fact that there is a reasonably close correlation between rates of CO_2 evolution from the roots, and transpiration. It may, for example, require more energy to absorb from concentrated solutions than to absorb from dilute solutions, and it may require different quantities of energy to absorb from solutions of different salts.

In Table 2 will be found recorded: first, the quantities of CO_2 given off separately by the roots of two alfalfa and two sweet clover plants, at four different stages of growth; secondly, the weights of the four plants when harvested; thirdly, the average quantity of CO_2 given off by each plant (average of four determinations at four stages of growth), and the average quantity of CO_2 given of per unit weight of plant when harvested.

The sweet clover plants were larger, and gave off more CO_2 than the alfalfa plants, but the quantities per unit dry weight of plant appeared to be not significantly different. It should be noted, however, that on the plant weight basis the sweet clover plants evolved at least a little more CO_2 than the alfalfa plants, an advantage which is more strongly marked in another series of experiments (Table 6), where the CO_2 values, in relation to plant weight, are decidedly greater for sweet clover than for alfalfa.

In Tables 3, 4, 5 and 6 will be found the quantities of CO_2 given off at one or more stages of growth, by the roots of the following crop plants: barley, wheat, rape, buckwheat, peas, vetch, alfalfa. It is not considered that the determinations recorded in these tables are sufficient to prove conclusively that there are, or are not, significant differences between the quantities of CO_2 given off by the roots of these plants. Further experiments are projected, especially of the kind reported in Table 2, in which the CO_2 given off by the roots of alfalfa and sweet clover was measured at a number of stages of growth. These seem likely to yield more conclusive results. The experiments reported in this paper do, however, give us some idea of the quantities of CO_2 given off by the roots of farm crop plants in general.

Table 2—CO_2 EVOLVED FROM ROOTS, IN RELATION TO THE WEIGHTS OF THE PLANTS. Series B.

		Alfalfa	Alfalfa	Sweet Clover	Sweet Clover
CO_2 Evolved from Roots in 48 hours Aug. 21 - Aug. 23, 1923.		11.1 mgm.	12.3 mgm.	25.8 mgm.	26.3 mgm.
CO_2 Evolved from Roots in 48 hours Sept. 11 - Sept. 13, 1923.		22.9 "	28.8 "	36.7 "	41.7 "
CO_2 Evolved from Roots in 48 hours Oct. 16 - Oct. 18, 1923.		21.7 "	31.0 "	30.7 "	39.0 "
CO_2 Evolved from Roots in 48 hours Nov. 5 - Nov. 7, 1923.		26.0 "	33.0 "	38.9 "	40.4 "
Plants 145 days old	No. of Plants	1	1	1	1
Harvested Nov. 8 1923.	Tops green	15.55 gm.	15.7 gm.	11.25 gm.	27.35 gm.
	Roots wet	17.1 "	24.6 "	32.8 "	44.3 "
	Tops dry	5.11 "	4.8 "	2.91 "	7.1 "
	Roots dry	5.41 "	5.55 "	9.52 "	10.72 "
	Total dry	10.52 "	10.35 "	12.43 "	17.82 "
CO_2 Evolved from Roots Aveg. of 4 determinations at 4 stages of growth		20.4 mgm.	26.3 mgm.	33.0 mgm.	46.8 mgm.
"	—per gm.d.m. of roots	3.8 "	4.7 "	3.5 "	4.4 "
"	—per gm.d.m. of whole plant	1.9 "	2.5 "	2.7 "	2.6 "

In Table 3 it will be noted that vetch and peas gave off more CO_2, in relation to the size of the plants, than barley, wheat, and rape. However, it will also be noted that the vetch and pea plants were much smaller than the others, and this may account for the differences, because, first, the quantity of CO_2 given off from the roots of very small plants may be greater, in relation to the size of the plants, than that given off by the larger plants, and, second, the probably error is greater when only a small amount of CO_2 is measured.

The barley and alfalfa referred to in Table 4 are of different ages, but of somewhat similar sizes. There is no significant difference in the quantity of CO_2 given off by barley and alfalfa in this experiment, when the quantities are considered in relation to the sizes of the plants.

In Table 5 it may also be noted that, in proportion to the sizes of the plants, peas gave off more CO_2 than barley or buckwheat. Here however, as in the experiment recorded in Table 3, the pea plants are much smaller than the other plants with which they are compared.

In the determination recorded in Table 6 it will be noted that sweet clover gave off more CO_2 in relation to its size than either alfalfa or rape.

Let us now estimate and compare the quantities of CO_2 produced in soil by the decay of organic matter, and the quantities given off by the respiration of the roots of the growing crop. The quantity of organic matter annually removed by decay from a soil well supplied with reasonably active organic matter is not far from three-quarters of a ton per acre, the decomposition of which would produce about 3000 lbs. of CO_2 (The factor, .471, is commonly used in estimating the quantity of organic matter from the weight of CO_2 given off by its oxidation). This is probably considerably more CO_2 than would be produced during the growing season by the respiration of the roots of a crop growing on the same acre of land. Supposing a wheat plant, by respiration, gives off CO_2 from its roots at an average rate of 10 mgms. per day during a growing season of 100 days, it then gives off 1 gm. during the growing season. Now if there are 300,000 plants growing on an acre, the quantity of CO_2 given off by the roots in the soil would

Table 3—CO_2 EVOLVED FROM ROOTS, IN RELATION TO THE WEIGHTS OF THE PLANTS. Series C.

		Barley	Barley	Wheat	Wheat	Rape	Rape	Peas	Peas	Vetch	Vetch
Plants 73 days old, Harvested March 17, 1923.	No. of plants	6	5	6	5	5	5	6	4	4	6
	Tops green	38.9 gm.	38.1 gm.	44.1 gm.	32.7 gm.	45.8 gm.	37.1 gm.	9.2 gm.	8.3 gm.	3.7 gm.	7.55gm.
	Roots wet	20.6 "	16.1 "	20.8 "	16.4 "	7.2 "	4.0 "	3.9 "	2.5 "	3.75 "	8.15 "
	Tops dry	7 "	4.85 "	7.8 "	5.55 "	4.9 "	4.15 "	1.75 "	1.6 "	.85 "	1.72 "
	Roots dry	5.9 "	4.25 "	6.7 "	4.05 "	1.8 "	.85 "	.43 "	.36 "	.31 "	.7 "
	Total dry	11.6 "	9.1 "	14.5 "	9.6 "	6.7 "	5.0 "	2.18 "	1.96 "	1.16 "	2.42 "
CO_2 Evolved from Roots in 47 hours, March 15—March 17, 1923.		30.5mgm	22.2mgm.	27.1mgm.	21.1mgm.	18.5mgm.	14.5mgm.	7.5mgm.	6.8mgm.	7.4mgm.	11.0mgm.
CO_2 Evolved from Roots in 47 hours, per gm. d.m. of roots		5.2 "	5.2 "	4.0 "	5.2 "	10.3 "	17.0 "	17.4 "	18.9 "	23.9 "	15.7 "
CO_2 Evolved from Roots in 47 hours, per gm.d.m. of whole plant		2.6 "	2.4 "	1.9 "	2.2 "	2.8 "	2.9 "	3.4 "	3.5 "	6.4 "	4.5 "

Table 4—CO_2 EVOLVED FROM ROOTS, IN RELATION TO THE WEIGHTS OF THE PLANTS. Series D.

		Barley	Barley	Alfalfa	Alfalfa
Barley plants 45 days old					
Alfalfa plants 114 days old	No. of plants	5	6	5	4
Harvested May 25, 1923.	Tops green	23.40gm.	16.65gm.	17.75gm.	11.10gm.
	Roots wet	12.3 "	11.8 "	12.7 "	14.2 "
	Tops dry	4.2 "	2.82 "	3.47 "	3.1 "
	Roots dry	4.75 "	4.8 "	2.5 "	2.98 "
	Total dry	8.95 "	7.62 "	5.97 "	6.08 "
CO_2 Evolved from Roots in 41½ hours May 23 - May 25, 1923.		25.2mgm.	27.1mgm.	15.1mgm.	17.0mgm.
CO_2 Evolved from Roots in 41½ hours per gm. d.m. of roots		5.3 "	5.6 "	6.0 "	5.7 "
CO_2 Evolved from Roots in 41½ hours per gm. d.m. of whole plant		2.8 "	3.6 "	2.5 "	2.8 "

Table 5—CO_2 EVOLVED FROM ROOTS, IN RELATION TO THE WEIGHTS OF THE PLANTS. Series E.

		Barley	Barley	Peas	Peas	Buckwheat	Buckwheat
Plants 35 days old	No. of plants	6	6	6	5	6	5
Harvested July 11, 1923.	Tops green	20.7 gm.	23.7 gm.	9.05gm.	9.75gm.	59.2 gm.	62.8 gm.
	Roots wet	20.8 "	19.9 "	3.5 "	2.75 "	11.2 "	11.0 "
	Tops dry	4.46 "	5.14 "	1.88 "	1.88 "	6.9 "	7.1 "
	Roots dry	7.05 "	7.35 "	.43 "	.31 "	3.30 "	3.73 "
	Total dry	11.51 "	12.49 "	2.31 "	2.19 "	10.20 "	10.83 "
CO_2 Evolved from roots in 26 hours, July 10 - July 11, 1923		24.5mgm.	22.4mgm.	8.5mgm.	8.4mgm.	20.6mgm.	34.1mgm.
CO_2 Evolved from roots in 26 hours, per gm.d.m. of roots		3.5 "	3.1 "	19.8 "	27.1 "	6.2 "	9.1 "
CO_2 Evolved from roots in 26 hours, per gm.d. of whole plant		2.1 "	1.8 "	3.7 "	3.8 "	2.0 "	3.1 "

Table 6—CO_2 EVOLVED FROM ROOTS, IN RELATION TO THE WEIGHTS OF THE PLANTS Series F.

		Rape	Rape	Alfalfa	Alfalfa	S. Clover	S. Clover
Wheat and Rape plants 60 days old,	No. of plants	1	1	6	6	6	6
Alfalfa and Sweet	Tops green	40.6gm.	43.0 gm.	6.1 gm.	5.3 gm.	14.6 gm.	14.5 gm.
Clover plants 50 days	Roots wet	18.5 "	15.6 "	8.0 "	9.5 "	12.9 "	16.5 "
old. Harvested Aug.	Tops dry	6.35 "	6.65 "	1.75 "	1.50 "	2.95 "	2.9 "
5, 1923.	Roots dry	4.55 "	3.9 "	2.05 "	3.45 "	4.35 "	6.5 "
	Total dry	10.90 "	10.55 "	3.8 "	4.95 "	7.3 "	9.4 "
CO_2 Evolved from roots in 48 hours Aug. 3 - Aug. 5, 1923.		31.3mgm.	25.2mgm.	9.8mgm.	12.0mgm.	24.8mgm.	39.9mgm.
CO_2 Evolved from roots in 48 hours per gm. d.m. of roots		6.9 "	6.5 "	4.8 "	3.5 "	5.7 "	6.1 "
CO_2 Evolved from roots in 48 hours per gm. d.m. of whole plant		2.9 "	2.4 "	2.6 "	2.4 "	3.4 "	4.2 "

be 300,000 gms., or about 660 lbs. per acre. This is probably a fairly conservative estimate, since the larger plants experimented with nearly always gave off at least 10 mgms. per day. In some cases they gave off more than double this quantity.

It seems fairly evident that the quantity of CO_2 produced in soils by the decomposition of organic matter is greater than the quantity given off by the respiration of the roots of the growing crop. It is very probable, however, that a unit of CO_2 given off by the roots is more effective in bringing plant food into solution, within reach of the plants, than a unit of CO_2 produced in the soil by the decomposition of organic matter. Much has lately been written regarding the important effect which CO_2 from the soil has upon the rate of photosynthesis. In this connection it is worth noting that the CO_2 from the roots would be returned most rapidly to the soil air, and thence to the atmosphere surrounding the green leaves, just above the soil, at the time when the plants would need it most for photosynthesis, whereas part of the CO_2 from the decomposition of organic matter would be returned to the atmosphere at times when the plants were either not growing actively, or not growing at all. Hence the CO_2 evolved from the roots may play a much greater part in the economy of the plant than its proportion to the total amount of CO_2 produced in the soil would indicate.

SUMMARY

A simple method is described of measuring simultaneously the rates of CO_2 evolution from the roots of growing plants, and transpiration.

A number of measurements made with various crop plants are recorded, and it is shown that there a reasonably close correlation between the rates of transpiration and of CO_2 evolution from the roots.

The data presented are not sufficient to prove that there are, or are not, important differences in the total quantities of CO_2 given off by the roots of different crop plants during their periods of growth, for a given weight of dry matter produced.

From the data at hand it is estimated that a good deal more CO_2 is normally produced in the soil each year by the decomposition of organic matter, than is produced during the growing season by the respiration of the roots of a growing crop. It is suggested, however, that the CO_2 from the roots may play a much greater part in the economy of the plants than its proportion to the total amount of CO_2 produced in the soil would indicate.

The possible importance of CO_2 produced in the soil as a solvent of plant nutrients, and as an immediate source of CO_2 for photosynthesis, is discussed briefly, and various suggestions for further experimentation are made.

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The Education of the Farm Boy.*

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There are two definite lines of work facing agricultural leaders and teachers. First, research work, second, dissemination of the knowledge that has been obtained by experience and investigation. In research work there are many problems awaiting solution. All agriculturists, farmers as well as teachers, are agreed that thoroughly trained men are needed to work continuously at these problems. Such men should be comparatively few in number, should be given every facility for work, and should receive adequate compensation so that they are not worried by the economic questions of daily life.

I am particularly interested at this time, however, in the second line of work, that is, the teaching of agricultural science and practice. It is easy in our enthusiasm for big Colleges and efficient research departments to forget that the ordinary farmer is not using one-half the knowledge already possessed by the best teachers. Since agricultural practice lags woefully behind modern scientific knowledge a special attempt should be made to get more information to the young men on the farms.

The agricultural experts may reply that efforts have been made to reach larger numbers of farmers by the establishment of Schools of Agriculture and the giving of Short Courses. The trouble with many of these schools is that they have not been managed and taught by experienced and successful agricultural teachers, and the courses have been too short to appeal to any large numbers.

The work of teaching divides into two headings: First, teaching and training young men for professional work in agriculture; Second, teaching and training the men who are to earn their living by actual work on the farm. It is to this last phase of agricultural education that I invite attention in this article. The courses given by degree-conferring colleges cover four years of study. These courses are of value to the young man who can afford to spend four years and two or three thousand dollars getting a College education. The work is scientific, the training excellent and the College life is full of interest. I only wish that every farm boy in Canada could and would take such a course. However, this is manifestly impossible as not even one-tenth of the farm boys will spend time and money to take a four years' course. The degree courses will train enough men for the work of research and teaching, with a few left over to return to the farm.

What can be done, then, for the thousands of boys who cannot take a four years' course and yet are sorely in need of help in solving their farm and community problems? I think we must admit, first of all, that the Agricultural College should reach as many of them as possible. The County Representative will help a great many, provided he is the right kind of man. The district Short Course will help many more, but, nothing can take the place of a College course with its influence upon the whole life of the boy. He not only needs information but he needs training, inspiration, leadership, friendship with wide awake teachers, the liberalizing effect of acquaintance with boys from different sections and the other fellow's viewpoint. All these things he gets best at a College.

What course can be given him that will accomplish the most, in the time and for the money that he will feel justified in spending? Various courses have been suggested. Some Colleges have tried a two years course. This will not give us what is needed as it is still too long and expensive to appeal to the large numbers who should get technical training in agriculture. Let me here again emphasize the fact that I am not thinking of the few who can take a college course but of the many who should get some help and who are now getting nothing.

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Another plan has been to give a one year course; this is also open to objection. The boys must be away from home in the fall and they must raise several hundred dollars at once. In addition it has the objection that all the work is given in one year and the student hardly finds himself in the rush of college work before it is all over and he is back at the farm with a great mass of poorly digested information. He has not had a chance to go home and try out some of the things learned before finishing his course, and, therefore, he has no chance to question his teachers again after a season's test of his new knowledge.

Another plan that has been tried is a three-month course. This may be cheap enough but is too short and is open in a still greater degree to the objection just given for the one year course. It is a rush and a whirl and home again with too many facts and too little training.

A course consisting of two three-month periods, given in two separate years appeals to me as most likely to give what is needed for the greatest number. The work would begin right after the new year and continue until April 1st. This gives the farm boy a chance to finish the fall work; he gets the fall plowing done and may even get all, or a part, of the winter's wood cut. He is not called upon to leave home in October when the weather is open and his time can be used to good advantage on the farm. He is not obliged to spend extra money in travelling expenses in making a trip home for the Christmas holidays. He goes to school the first of January and stays there until his three-month course is finished.

The first three-month term gives the boy a good start but it is not enough. During the following spring and summer the College teachers should keep in touch with every boy who has taken the course. Even if there were great numbers of them, provide teachers, who are enthusiastic farmers, with enough time and help to correspond with and, if possible, visit every boy during the summer. Make each one feel that you are interested in him personally. If agricultural education is ever to reach the great mass of farm boys real personal work must be done. The boys from outlying districts and remote farms must be made to realize that they are a part of the national life and that the success of agriculture depends on them as well as upon the boys in the centers. Every Agricultural College and Provincial Department of Agriculture should spend some money studying boys and girls as well as plants and animals. I have already admitted that there are big problems to be solved in Agriculture, but in my opinion the biggest one is the problem of how to reach and inspire all the farm boys instead of only a selected few. Therefore, follow up the boys who took the winter course, keep in touch with these prospective farmers. It is good salesmanship. It is the method used by all successful business firms. We, as agricultural teachers, have a big thing to sell to the farm boy, that we believe will be a great help to him all his life. Let's get out of the classroom routine and get in touch with the boys on the farms.

Having kept in touch with him all summer with friendly interest, he will be anxious to come back the first of January for another three-month term at the College. The spring and summer work has brought him some discouragements; the home folks and neighbors are skeptical about his new methods learned at College and taught by "book farmers." Some of the things he tries, do not turn out as he expected. He is badly in need of another term at the school to check up his ideas, to correct wrong impressions, to emphasize first principles, and settle him firmly in his determination to improve his methods of farming. The second term is worth even more than the first. All teachers notice how quickly the students get to work the second year and what great improvement has taken place in their ability to study. They are familiar with the class-room methods, with the teachers and with the whole of College life. This second term puts them on their feet, gives them confidence and a good start along the way toward becoming first-class farmers.

The expense of such a course would not be heavy and would be divided between two years. The three-month term should not cost much above $100.00. An advertising campaign could be carried on urging every farmer to spend $100.00 per term for two terms in getting a good start in his agricultural education. Young men could be encouraged to save money to take the course. It could be

made to appeal to their pride to be graduates of the Farmer's Course. Agricultural Societies, Women's Institutes and Creamery organizations could use their influence to get boys interested. I see no reason why large numbers could not be secured.

The instruction to be given in this course of two three-month terms must be of the most practical kind. The young men who will take such a course expect to go back to the farm. The course will not allow time for, and most of the students will not have the interest in, so called "cultural studies". The man who cannot see the "cultural" value in teaching a farm boy how to do his farm work properly should not be appointed a teacher in this school. Furthermore no great amount of time can be spent in giving these farm boys a complete elementary course in even such valuable subjects as biology, chemistry and botany. Courses in these subjects should be arranged entirely from the standpoint of the boy who is to work on the farm. The life history and control of harmful and beneficial insects, the simplest study possible of the chemistry of soils, fertilizers and feeds, the identification and life history of farm plants and weeds, may all be given in such a way as to help and interest the young farmer. All these subjects furnish a certain amount of cultural training.

When the student begins his work it must all appeal to him as being useful on the farm. The idea that the teacher is best qualified to give the student what he wants, whether the student likes it or not, will not do here. The boy and his father must feel that time and money are being used to get what will help the boy make a better living on the farm. Otherwise, the boys will not take the course. It is all well enough to insist that these scientific and cultural studies are valuable, but the boy we are after has not a foundation of knowledge to appreciate them and if forced to take them will often give up the course. Boys coaxed into starting such a course have often become discouraged and even embittered, have decided that agricultural education was useless and have given up in despair. A study of actual farm problems would have held them and made them enthusiastic for better farming.

When the two three-month terms have been satisfactorily finished the student will be given a certificate stating that he has graduated from the Farmer's Course.

Among the men who take this course will be some who will develope an aptitude and a love for study. For such men the Farmer's Course certificate should admit them to the second year of the two-year professional course. If they are then able to make up the studies necessary for College matriculation they will be in a fair way to go on with their College work and eventually obtain a College degree. These will furnish some of the best men in the degree course, as they will have farm experience and ambition.

It has been decided that such a course as I have outlined will be given at the Nova Scotia Agricultural College beginning Jan. 1st, 1925.

The subjects to be taught will be selected from the following list:—

Soils and their treatment.

Fertilizers—composition, buying, home-mixing and application.

Barnyard Manure—value, methods of preservation and application.

Crops—Botanical characteristics, life history.

Poultry Husbandry.

Animal Husbandry—horses, cattle, sheep and swine.

Dairying—with special reference to the handling of milk and cream.

Economic entomology—useful and injurious insects and their control.

Horticulture—orchards on the general farm.

Olericulture—With special reference to the home garden.

Farm Mechanics—farm machinery, gasolene engines, electric lighting for farms, etc.

Business methods—farm accounts, letter writing, use of banks and banking, notes and business forms, credit.

Agricultural Societies—debating and speaking, presiding at meetings, rules of order.

Music—Glee club and community singing.

The success of this course will depend largely on the type of teacher selected. Inexperienced men, who do not know how to teach, must not be appointed. No matter how brilliant they may have been in College, the men who are not enthusiastic about farming and who do not have the real teacher's faculty of imparting knowledge to others will be worse than useless. The teachers must be selected from experienced men and made to understand that this is a big job, needing all the fortitude and patience of the true missionary.

The Place of the Extension School in the Agricultural Education System.*

W. H. BRITTAIN

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Professor J. M. Trueman has developed the idea of a "Farm Course" adapted chiefly to the needs of the average farm boy who aim subsequently to return to the farm. The development of such a course along sound lines would undoubtedly be a step in advance of anything the Agricultural College has done for the farm boy, but I am concerned, at present, in explaining how it is proposed to relate the work of this course to the other activities of the institution and more especially to that of the Agricultural Extension School and to the regular degree course. With a little intelligent effort it should be quite possible to make our two or three day short courses, the extension school, the farm course and the regular course, all definite parts of a definite educational policy and to weave our, at present, scattered efforts into one continuous fabric. The two to three day short courses should be made to advertise the extension course, the latter to feed the farm course and it, in turn, to nourish the regular or degree course.

The Agricultural Extension School, providing as it does four weeks of intensive training along lines best adapted to the needs of the district in which it is held, carried out in a strictly rural setting, without the distractions incidental to an urban environmen and with no expensive buildings or elaborate equipment to overawe the student with the machinery of instruction, appears to offer one of the most promising fields for constructive effort upon the part of Departments of Agriculture. It may be said that these have been tried with success in the past, but that they too have failed to meet the present emergency. There are several good reasons for this. One of the most important of these is that in some cases, at least, the courses have been too long and that too much has been attempted. The function of these schools should be to arouse an interest in better farming among the young men and to encourage them to study their own business on their own farms. To attempt to duplicate the work of a college course without suitable laboratories, equipment or instructors, or to prolong such a course beyond four or six week is, in the opinion of the writer, to invite failure. Longer courses should be offered only at the central institution. Another difficulty is to secure teachers of the right type for the work, since a man who makes a success as a district representative is not necessarily of the type to succeed as a teacher. In a recent article on the subject of extension schools it was stated that the attendance was poor even though the boys and their fathers were pleaded with in an effort to secure attendance. This also indicates a possible reason for the non-success of such courses.

Realizing the foregoing facts and recognizing the need, under present conditions, of increased activity along educational lines, the Nova Scotia Department of Agriculture, in spite of severely curtailed funds owing to the loss of the Agricultural Instruction Grant, conducted two such schools during the past winter and, in spite of the prevailing depression, the interest and enthusiasm of the attending students was an inspiration to the instructors. The inauguration of this important step was made at the request and with the active support of the communities concerned. There can be no question but that such courses, properly conducted, result in a quickened interest in agricultural matters in the districts served by them and we will be neglecting our opportunities if they are not made part of an intensive movement for the revitalization of rural life.

It seems tragic to allow the fires of enthusiasm and interest kindled by such courses to die down for want of fuel. Every one of these boys actually lives upon a farm and

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each one of them has definite problems to solve. It should be, if we know our business, a comparatively simple matter to lay out, for those students desiring it, a supervised course of instruction in a limited number of subjects, that would assist them in solving these problems. A set of simple lessons could be devised by the instructors concerned and certain texts might even be required for study, but as far as possible the aim would be to get as far away as possible from book learning. If the student were a dairy farmer, he might be given instruction in testing his cows. If he sent his cream to the creamery, he might, as one exercise, be required to bring it up to the first grade. If he had a field that required drainage, he might be required to make a drainage plan under the supervision of the instructor in farm engineering. The poultry instructor might require him to cull his flock. The botanist might direct him in the study of the weed seeds occurring as impurities in seed grain or cause him to make simple studies in the development of fruit spurs, while he might undertake a simple experiment in orchard spraying or dusting under the direction of the entomologist. In this way the student would be grappling not with imaginary problems, but only with those which were of vital interest to him. Surely such teaching would not only be just as good as instruction held within the four walls of the class room, but it should be infinitely better from the standpoint of the future farmer, and certainly the working out of this idea would appear to hold out more hope of bridging the gap between teaching and practice than anything we have ever attempted in this country. The foregoing plan, which it is now proposed to carry out, includes and goes far beyond anything done in so-called "correspondence courses."

The scheme would be incomplete, however, if it were not possible to fit it into the present educational system in technical agriculture and this also forms a definite part of our plan. The student who has taken a course at the extension school and a year of supervised practice on his farm should be entitled to enter the second year of the "Farm Course" outlined by Professor Trueman. We believe that it is quite possible to devise a curriculum to meet the needs of such a case. When the student who enters the farm course in this way, completes it, and finally returns to his farm, he should have a better training, a more practical training and one infinitely better suited to his individual case, than if he had taken the regular or degree course, or, indeed, if he had entered the farm course direct.

There will undoubtedly be some students who, after taking the farm course will desire to pass into the regular or degree course. For the benefit of such students, machinery is to be provided whereby they can enter on the second year of this course. Indeed it might be preferable if all our students could be induced to enter the regular course through this channel. What repels many otherwise promising students and renders them antagonistic to the whole scheme of agricultural training, is being forced to take subjects which they find difficult and the practical significance of which they do not have sufficient training to appreciate. But *interest* is the father of *effort* and once interest is aroused it needs no argument to convince the student of the value of the same subjects that would only have aroused a feeling of resistance if offered to him in the beginning. Any student, therefore, who has completed the farm course will be entitled, if he so desired, to enter the second year of the regular or degree course. He will already have had more than a year's work in purely agricultural subjects and it should be a simple matter to arrange the curriculum to enable him to work off such subjects as zoology, some branches of chemistry, advanced English, etc., not taken at all in the farm course, but ordinarily given in the first year of the degree course. In addition such students will be required to carry out certain problems at home between the two terms of study, of a similar nature to those outlined for students who have taken the 4-weeks extension course, as well as in non-technical subjects in which they might require further study. They will furthermore be finally required to bring themselves up to the matriculation standard and, in doing so, will be given every possible assistance including whatever additional tuition they may require. Any one of these students, after having completed another full academic year, will then not only have had the opportunity to make good his academic deficiencies, but he will have the additional advantage of greater farm experience and

more truely practical instruction in the purely agricultural subjects.

If it is true as has been stated by competent authorities that seventy-five percent of the factors that make for success or failure in any chosen line of work are personal qualities and that only twenty-five percent come through training, then surely it is one function of the agricultural college to discover and draw out those who have the necessary qualities to succeed as technical agriculturists. The foregoing plan ought to have that effect, for any student who evidences the capacity, perseverance and determination to qualify himself in the manner described, who has had plenty of farm experience, plus supervised home instruction, plus technical training, plus the regular academic qualifications, should be better qualified for a professional position than one who enters the regular course with good academic training, but without this practical background. Certainly, also, we could be assured of his having superior personal qualities. It cannot be too strongly urged, however, that our main concern should be for the great majority who will return to the farm and not with the few who proceed with work toward a degree. It is on this latter group that, in the past, we have devoted far too large a share of our time, energy and interest, to the detriment of the more important group.

The important question arises at this point—what do our agricultural colleges exist for? Are they to train men to fill technical positions in the government service, the agricultural colleges and schools, the agricultural press and commercial organizations, or for the purpose of preparing the student for a more effective life on his own farm? The answer is often given, "Both,"—and it is chiefly the attempt to realize this dual purpose that has prevented our agricultural colleges from achieving their fullest usefulness. The kind of training required to make a good farmer is entirely different from that needed to prepare a man for any of the lines of effort that we have enumerated. The two purposes do not mix. The obvious answer is to divorce the two ideas entirely in the curriculum of our agricultural colleges and to deal with each separately, but also to provide a bridge whereby a student may pass from one class to the other. Briefly, the idea is to continue with the matriculation standard or its equivalent for entrance to the degree course, providing for those who wish to train themselves for actual farm work and for those who would like to take the degree course but are debarred by the entrance requirements, the kind of course outlined by Professor Trueman, with the possibility of later entering the degree course upon making good any academic deficiencies. It is absolutely essential to the success of this scheme that those entering the regular course in the regular way should come with the full academic qualifications. To make any other arrangement would be to kill the farm course and to go contrary to the idea behind it, for reasons that should be obvious to any thinking person.

Traditionalists may object to any modification of the matriculation standard preceding entrance to a course culminating in a degree. Indeed, it so happens that a contraversy is raging at the present time regarding standards of entrance to our agricultural colleges. The advocates of the regular matriculation requirement for entrance have, temporarily at least, won the day in Canada, as was the case long ago in all the leading American institutions. Their contention has been that students are in no position to grasp even the elementary facts of the fundamental sciences upon which agriculture is based without that minimum of preparatory work represented by the matriculation certificate. They contend that in the past our agricultural colleges have been turning out graduates below the standard of scholarship attained by graduates of the regular universities and that they have been attempting the impossible feat of rearing a solid edifice upon a foundationless base. They point out that much of the "research" work that has been done on our experimental farms and stations has been simply laughable, because of the investigator's ignorance of what constitutes scientific evidence, some of the so-called "practical" men being the greatest sinners in this respect. They state that the lack of stringent entrance requirements encourages the enrollment of students not able to enter the universities, but anxious to get some kind of a degree as quickly as they can, as a tiresome

but necessary preliminary to getting a "government job." They point to the fact that this practice offers no incentive whatever for the student lacking academic qualifications to make good his deficiencies. The result is that he is finally foisted on the public in a semi-educated condition without that necessary mastery of his profession that his degree is supposed to represent. To the contention that it is not necessary to graduate unqualified students even when entrance requirements are lax, the answer is given that when such students are admitted the inevitable tendency has been to lower the standard for graduation.

Those not in favor of the matriculation standard contend, on the other hand, that such a standard is shutting out the very boy that is wanted, viz., the boy with extensive farm experience, and encouraging a type that will never be of any benefit to agriculture from his lack of a proper practical back ground which, they maintain, is worse than an inadequate academic background. Some of them freely charge that those who advocate higher entrance requirements are chiefly animated by the idea that they must impress their university colleagues with the fact that they are real college professors and not mere teachers in a technical school. It is the same motive, they allege, that impels some professors, themselves with imperfect training, to impress their students by being "profound". They further point to the conspicuous success which has been achieved by exceptional students under the old system, which demanded no entrance requirements of any kind, who would have been shut out entirely had such a thing as a matriculation standard been then in vogue.

At first glance it seems impossible to reconcile these two conflicting viewpoints. Nevertheless, it is the opinion of the writer that the foregoing plan does, in fact, carry out the main ideas underlying each and, in addition, it is based on the soundest educational principals in that the student first learns to apply the training he has received before receiving further instruction.

SUMMARY

To summarize, these combined plans offer the following advantages:

1. *More students,* because of the greater number attending the extension courses who will get a taste for further study, and who will be enabled to take the "Farm Course" because it will be held during the "slack season" and, further, because of the greater attractiveness of such a course to the average country dweller.

2. *No increased expense for the institution,* because the work can be carried out by our present staff.

3. *Less expense for the student,* since part of his instruction will be carried out at home and a greater part of his time will be utilized on the farm during busy seasons.

4. *Better teaching,* because the instructors will not be constantly striving to harmonize two conflicting viewpoints in their teaching practice. This will naturally result in a more complete realization of the diverse aims of these two courses.

5. *Better satisfied students,* from each group securing the kind of instruction suited to its needs.

6. *Better trained students,* from the bridging of the gap between teaching and practice afforded by this method and from the "sifting" process that it will entail.

7. *Closer contact* between the college and the farm, and a closer realization of rural problems on the part of members of the college faculty, from the latter being compelled to assist in working out definite and individual farm problems.

Report of Committee on Graduate Study.*

FRANK D. ADAMS

Dean of the Faculty of Graduate Studies and Research, McGill University

The committee met and considered three plans for co-operation in graduate work among the Canadian Universities, which had been suggested by Professor Sage of the University of British Columbia, Dean Brock of the same university, and by the chairman, respectively.

Professor Sage's plan in outline is as follows. It proposes:

"(1) The creation of a national Graduate Study Board. This board is made up of one representative from each Canadian university which is ready to undertake Ph.D. work in whole or in part; this board to have the oversight of all Ph.D. work in whole or in part; this board to have the oversight of all Ph.D. work offered by any Canadian university. It is to accept candidates for the Ph.D. degree, and to assign such candidates to professors under whom they shall work. It is also to appoint examiners and to issue certificates entitling the successful caandidates to receive the Ph.D. degree.

"(2) The conferring of degrees is not to be a function of the board. It is suggested that the successful candidate receive his degree from the university under whose auspices his final examination is conducted.

"(3) It is suggested that a Royal Commission be appointed whose duty it shall be to settle the standard required for the Ph.D. degree. It would seem advisable that the commission be composed of five members selected as follows: One from the British Isles; one from France; one from the United States of America; and two from Canada.

"(4) After the Royal Commission had reported, it should be the duty of the board to make a thorough investigation into the status, personnel, equipment, etc., of any department of any university which offered to do Ph.D. work. The board should also be empowered to refuse to allow that university to do graduate work in the department leading to the degree of Ph.D., if in the estimation of the board this work was not up to the standard set by the Royal Commission.

"(5) A candidate for the Ph.D. degree is to register provisionally at a Canadian university. His candidacy is to be accepted or rejected by the board at its next meeting, and a professor is to be appointed with whom he must consult concerning his work.

"(6) The candidate may move from one university during his course of study. Final examinations for the degree of Ph.D. will be conducted by the examiners named by the board, but not by anyone who has taught the candidate.

"(7) The degree of Ph.D. to be conferred by the university holding the examination, on receipt of a certificate from the board that the candidate has passed his examination and is eligible for the degree."

Dean Brock's proposed plan is set forth in his paper, read at the Eighth Conference of Canadian universities, held in Winnipeg in 1922, which is printed as Appendix I. in the report of this meeting.

The plan suggested by the Chairman (Dean Adams) may be set forth as follows:

"The higher degrees to which a student who enters the graduate school in any Canadian university proceeds are: (a) The degree of Master (of Arts, Science, Agriculture, etc.); (b) the degree of Doctor (of Philosophy, Music, etc.)

"*For the degree of Master.*—To enter the graduate school of any university it should be first agreed that the student must already have received a degree of Bachelor (of Arts, Science, Agriculture, etc.). On entering the graduate school for the purpose of proceeding to the Master's degree, he should be required to follow a course of one year's resident graduate study, and to that end would be required to:

"(*a*) Select one subject, or two subjects (a major and a minor).

"(*b*) This subject, or the major subject if he selects two, must be a subject for which

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he has been suitably prepared in the preliminary work of his undergraduate course.

"It is understood that the Master's degree represents an attainment in advance of Honour B.A. or B.Sc. standing in the subject which he selects, the Master's degree not being a degree which represents merely a wider general education but one which gives the student advanced training in some subject which he has already studied for at least one year, or two years, before entering the graduate school. A student, for instance, cannot have followed an undergraduate course, even with honours, in Classics or Chemistry, and then enter the graduate faculty taking an entirely different subject, such as Hebrew or Botany. If he has followed an undergraduate course in Classics, he must continue his course in that subject, or if he desires to take post-graduate work in Botany, he must have had an adequate undergraduate preparation for the work in this subject.

"(*c*) The attainments in the subject which the student selects to follow, before the Master's degree is conferred upon him, must represent not only a B.A. honour standing in the subject, but must go beyond this, so that if the student has taken an ordinary degree he must, having entered the graduate school, first cover the ground of an honour undergraduate course in the subject which he has selected, and then proceed to more advanced study in the same subject. If he cannot do this in one year, it would be necessary for him to devote two or more years to study before he can proceed to the degree of Master.

"(*d*) The course of instruction leading to the Master's degree is one which will represent formal instruction to the extent of eight lectures per week throughout the session.

"These may be replaced wholly or in part by colloquia given in connection with extended courses of reading, or by laboratory work. These colloquia or this laboratory work may be correlated with lecture work on the basis that one hour of colloquium would be equivalent to 1½ hours of lecture, and 2 hours of laboratory work would be equivalent to one hour of lecture.

"The student must prepare a satisfactory thesis on some appropriate subject.

"A student desiring to proceed to the degree of *Doctor of Philosophy*, must follow a course of study extending over at least three years:

"(*a*) He must first have received the degree of Master, and if the course taken complies with the conditions set forth above, he will be considered as having fulfilled the requirements of the first of these three years.

"(*b*) To ensure a certain breadth in the course of study, this course would require a major and a minor subject, the latter being cognate to the former. The subject or subjects taken in his course for the degree of Master would be those which he would continue to study in his course for the degree of Doctor of Philosophy.

"(*c*) The standard of attainment for the Master's degree having, under the proposals above outlined, been fixed for all Canadian universities, the student having taken this degree could follow the second year of his course for the Degree of Doctor of Philosophy in any university of Canada where he wished to continue his studies, and in which the second year of such a course is provided in the subject which he desired to study. He might even be permitted, if the arrangements of the university session make it possible, to take half year courses at different universities, or he might receive permission from the university at which he desired to present himself for his degree, to take one year of his Ph.D. course at some foreign university of recognized standing.

"(*d*) For the third year of his course, the student might, if he so desired, pass to a third Canadian university. In this year, the thesis would be written or completed.

"(e) The student might present himself for examination for the degree at the university in which he completed his course, or he might present himself at any of the universities between which his course of study has been divided.

"The examining university could protect itself and the value of its degree, by refusing to grant the candidate a degree if he did not fully attain the standing which this examining university required. Should the candidate fall short of this, he could be directed to resume his studies for a further specified period—a term or a year—with the right to present himself again at the expiry of this time.

"A plan such as outlined above would render the class-room and laboratory of every distinguished professor or teacher of every university in Canada open and readily accessible to any advanced student from any other university in Canada.

"The university would draw students, or fail to draw them, according to the ability and distinction of the professors filling its chairs.

"Neither would the fact that some university may offer scholarships in some subjects, while others do not, affect the situation. The scholarships might be thrown open to all students coming to the university courses in any year, or the university offering the scholarships might reserve them for men coming up from their own undergraduate faculties.

"Even such a plan might not serve to keep our best men from drifting into the universities of the United States; but it would, at any rate, offer every inducement that Canada can offer for them to complete their studies in the Dominion."

The committee, after a careful consideration of these several proposals, reached the following conclusions:

The plan of Professor Sage, which included a central committee or board with examining powers, was felt to be unworkable, although the underlying aim that a standard as nearly as possible uniform be maintained was in general approved.

The proposals of Dean Brock supplemented the idea of a central examining board by the further suggestion that the resources of material and men at Ottawa be made available, and that the graduate training in certain subjects be given in whole or in part at Ottawa under the direction of specially qualified men in the government service. The committee felt that in the matter of co-operation with the departments at Ottawa, valuable material was available in certain departments, as in the archives for the student of Geology; but in the opinion of the committee, the direction and control of the work of the student must rest definitely with the University to which the student was attached.

The plan outlined by Dean Adams was then considered. The committee decided to recommend this plan to the Conference in its general principles, the details to be worked out by some body elected for that purpose. Such details might include the minimum standard of attainment which might be considered a reasonable prerequisite in any subject before the student enters on the course for the M.A. or M.Sc. degree, and the minimum of actual tuition which might be established for the M.A. or M.Sc. degree, in cases where such degrees were to be accepted as representing one year's standing in the Ph.D. course. The committee further desired to suggest that a high standard for the Ph.D. degree could be set, and a reasonable measure of uniformity attained, by adopting the practice in each university of appointing to act with one internal examiner, two external examiners of distinction in the subject which the candidate proposed for his graduate, and particularly his thesis work.

In summary, the committee recommended as follows:

1. That in order to make fully available the resources for graduate work in Canadian universities, the requirements in the various universities be standardized to the extent that it may be possible for a student to pass from one university to another with full cerdit for the work already completed.

2. The co-operation with such departments at Ottawa as have graduate materials available, as for instance the archives and the geological survey branch, be established on the basis that the direction and control of the student's work for graduate purposes rest with the university to which the student is attached or with a co-operating university.

3. That the proposal to delegate powers to a central graduate board is not feasible.

4. That the university at which the student is a candidate for the Ph.D. degree appoint external examiners to act with examiners appointed from within the university, to act as an examining board for that particular candidate.

5. That a committee be appointed to consider such details as may be connected with the carrying into effect of the above recommendations, and to report.

Le Paysan Francais au Travail.

GEORGES BOUCHARD

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Pour bien faire comprendre la situation des travailleurs agricoles en France, il faut les ranger en diverses catégories qui ne se rencontrent généralement pas chez-nous. Il va sans dire d'abord qu'il n'entre pas dans mon programme de parler des grands propriétaires ruraux qui exploitent avec un art consommé des fermes considérables, et qui par leur contact presque quotidien avec les classes urbaines participent aux activitiés sociales les plus diverses. Ceux-là occupent une place toute marquée dans le développement de l'agriculture moderne par leurs méthodes qui s'inspirent des meilleures données de la science agronimique et par leur position sociale qui leur permet d'être de vrais apôtres du progrès rural. Rien chez eux ne revêt le caractère de simplicité traditionnelle des petits travailleurs de la terre dont je me propose de vous entretenir.

On peut compter en France un très petit nombre de dizaines de propriétés de plus de 1000 Ha (2471 acres c'est-à-dire, 12½ fois l'étendue moyenne des fermes du Canada.

Il y a ensuite près de 150,000 fermes de plus de 40 Ha (98 acres). Et le reste de la propriéte rurale se compose de 4½ millions de fermes de moins de 10 Ha (24 acres). Encore sur ce nombre, il y eu a 2,000,000 dont l'étendue ne dépasse pas 1 Ha. (2½ acre.)

Il faut tenir compte de cette division de la propriété en France pour apprécier à leur juste valeur les méthodes de culture en usage. Ce n'est pas dans ces 4½ millions de petites fermes qu'on peut s'attendre de trouver un outillage très perfectionné et très coûtenx. Un système de culture, qui en lui-même semble arriéré à l'observateur superficiel, peutêtre un systême très progressif suivant la nature et l'étendue des cultures auquelles il s'applique.

Le groupe des patrons et celui des salariés semble à égalité comme nombre; et les salariés ruraux sont pour la plupart sauf dans certaines régions, comme le Languedoc viticole et les grandes plaines à blé, des fils de propriétaires ou des propriétaires eux-mêmes de petits biens ayant tous en vue *l'accession* à la propriété.

L'amour des paysans français pour la terre avec laquelle ils sont unis, suivant le mot de Proudhon, "en légitime mariage" (d'après Michelet la terre est pour la paysan "une maitresse") explique leur ardeur au travail et leur esprit d'économie, comme il explique divers phénomènes sociaux très importants.

Le paysan a une tendance à attribuer une valeur particulière au champ sur lequel ses ancêtres et lui ont peiné et qui forme ce qu'il appelle *du bien de famille.*

Le pauvre laboureur qui, courbé sur le sillon, a confié à la terre une semence qui exige une longue gestation avant de s'épanouir à ses flancs, s'attache à elle comme l'époux s'attache à celle qui est la dépositaire affectueuse des trésors d'une autre vie naissante. "Il a fécondé la terre, dit Bonnemère, et il est de moitié dans l'acte sublime de création qu'elle accomplit chaque année. Il se sent lié à son oeuvre: là est son amour et sa vie!"

"Le paysan, continue le même ($_1$) est amoureux de la terre. A la mort du père, il s'agit de diviser tous ces champs morcelés. Rude tâche! Les divers morceaux n'ont pas la même qualité. Que faire? Diviser chaque champ en deux, trois ou quatre morceaux. *Qui Terre a Guerre a,* dit le proverbe.

"Vous avez cent voisins qui vous volent ou se croient volés par vous. A les entendre, pas un d'eux dont le champ ne diminue visiblement d'année en année. Prenez garde! là, à vos pieds, cette pierre que vous heurtez, qui effleure le sol, *c'est une borne*! C'est le désespoir du juge de paix, la fortune de l'huissier, de l'avocat de l'avoué. Sur cette pierre Thémis (la fausse déesse) a bâti les fondements de son temple."

"Plus de repos, plus d'aisance! car frappé d'une maladie que j'appellerai la *maladie de la terre,* chacun se prive, prive sa femme et

($_1$) Histoire des Paysans p. 351.

ses enfants, travaille à en perdre repos et repas."

Cette page écrite au milieu du siècle dernier, ne manque pas encore de vérité aujourd'hui malgré les nombreuses infidélités et les regrettables abandons dont la terre est victime!

Le partage en parties égales de l'héritage paternel tel que prescrit par la loi française, a contribué pour une large part au morcellement des propriétés et aussi à la limitation volontaire des naissances et à cette *disette d'enfants* dont souffre la France.

En Normandie, comme on m'a répété à mon dernier voyage, il arrive souvent que les petits lopins de terre qui composent l'héritage paternel soient encore subdivisés quand les fils ne parviennent pas à s'entendre pour le partage.

Comme chaque héritier a peur que l'autre ait la meilleur lopin, il réclame la division en parties égales de chaque parcelle. De là, une cause profonde de morcellement. L'attachement à la terre et les dispositions légales ne font qu'accroître cette division extrême de la terre de France.

Qui n'a été frappé par l'aspect des campagnes de France avec leurs mosaïques de lopins d'avoine, de blé, de luzerne, de pois, de sarrazin de betteraves, etc.? Les champs appartenant à divers propriétaires présentent des contours et des couleurs qui les font ressembler à des damiers. La culture de ces parcelles souvent éloignées ne se fait pas sans des pertes de temps considérables. Le développement de la culture mécanique et le haut prix de la main-d'oeuvre rendent urgent de nos jours le remembrement de la propriété paysanne tel qu'il a été entrepris par certains économistes et tel qu'il est désiré par la majeure partie des Français. La loi votée par le Parlement, le 27 novembre, 1918, pour permettre l'aggrégation des parcelles séparées se heurte inévitablement à des habitudes invétérées et à l'attachement presque sans pereil des paysans français à leur sol.

On peut se faire une juste idée de l'activité paysanne française en considérant ces champs où la mort et la dévastation ont régné pendant de longues années et qui, aujourd'hui se couronnent de récoltes presque sans égales. Ne mesurant ni son temps, ni sa peine, accroché à son sol par toutes ses fibres, le paysan français demeure l'élément de force, de travail de stabilité qui a le plus contribué à donner à la France, dans le monde, la figure d'une nation merveilleusement ordonnée et équilibrée. C'est avec raison que M. Guillon pouvait dire à la Fête du Blé de Saint-Galmier, l'été dernier, que "le relèvement de la France victorieuse mais meurtrie, dépend en bonne partie de l'homme des champs. C'est lui qui, après avoir gagné la guerre, effacera par de nouvelles et florissantes cultures, la trace douloureuse des tranchées."

"Le Ministère des Régions Libérées estime à 1,982,209 hectares (4,888,000 acres) la superficie des terres cultivées qui étaient à reconstituer à l'armistice et à 3,362,644 hectares (8,310,000 acres) la superficie totale des regions dévastées. On a évalué a 116,000 hectares (287,000 acres) cette surface qu'on a appelée la *zône rouge.* Là le coût des travaux de remise en état aurait dépassé la valeur même du sol" (Augé-Laribe 50-51).

Ceux qui ont parcouru comme moi les champs de bataille, après cinq ans de paix relative, ont dû être frappés par la ressemblance qui existe centre ces régions dévastées et nos régions de colonisation. Les paysans sont logés dans des petits baraquements en planches brutes recouvertes de papier goudronné au milieu de champs bouleversés à surface lunaire formés de cratères ou de mares à eaux croupissantes. Les plus petits trous d'obus font penser aux dépressions de terrain causées par l'essouchage. Ce sont donc des terres à recoloniser!

Notons cependant cette différence en faveur du colon canadien: il ne s'expose pas, à cheque coup de pioche, à frapper l'obus oisif qui va l'étendre mort sur le champ. Et de plus le colon de chez-nous, aux premières récoltes, bénéficie largement des éléments fertilisants que la nature a accumulés pendant de longs siècles, tandis que son cousin de France ne retrouve qu'une terre inerte que la guerre a stérélisée, car, vous n'en doutez pas, *le passage du Boche n'a jamais été un élément de fécondité.*

C'est le bas de laine, qui en 1870, a mis fin à l'occupation allemande et c'est encore l'accumulation des énergies et des vertus paysannes qui assurera, le triomphe des idées et des devises françaises!

M. Chéron avait bien raison de mettre ses espoirs patriotiques plus dans l'épi pacifique que dans les engins de guerre et de déclarer que "l'épi doit sauver le franc".

C'est cette *maladie de la terre* comme a l'a appelée était tellement prononcée que des cultivateurs, dans la région du Nord en particulier, passaient des journées entières aux champs "sous la voûte d'acier des obus qui s'entrecroisaient au-dessus de leur tête."

C'est un officier canadien qui a vu une femme de la région du Nord tapie dans sa masure au milieu du "No man's Land".

"Les Allemands m'ont chassée en 1870 et j'aime mieux mourir crevé par un obus que de quitter cette terre arrosée par les sueurs et le sang de ceux qui ont cultivé avant moi."

Est-ce insouciance ou ignorance du danger? Toujours est-il qu'un grand nombre de paysans ont été impassibles en face de l'envahisseur.

"Notre pensée dit le Docteur Labat, (Ame Paysanne 22-23) est encore émue du son rendu par l'âme paysanne au choc des armes.

"Lorsque notre voisine reçut la nouvelle que son mari ne reviendrait pas, sa douleur fit peine à voir. Mais le lendemain ayant jeté sur ses épaules quelques haillons de deuil, elle prit la charrue et laboura toute la journée en pleurant, suivie de deux petits enfants qui ne la quittèrent pas.

Qui donc ne l'a vue cette ferme, de long de toutes les routes de France! Dans la brume légère du matin, sa silhouette se dresse, poussant l'attelage sur la crète de la colline: l'horizon est barré d'un grand nuage noir, ce nuage de plomb qui depuis quatre ans nous oppresse. Mais le soleil, qui se lève, le traverse d'un rayon pour éclairer cette scène de labour d'une immortelle espérance. Au lendemain d'un jour où tout le monde a pleuré l'enfant a pris l'aiguillon de son père, et les deux grands boeufs de leur pas grave l'ont suivi".

La période qui a suivi le traité de paix n'a pas été une période de chômage pour le paysan qui sait que l'or n'est pas seulement dans les banques, mais dans le sol de France judicieusement cultivé. Il suffit de parcourir même hâtivement les campagnes de France pour s'assurer du degré d'activité des travailleurs du sol.

Qui n'a vu au crépuscule dans la plaine envahis d'ombre, ce laboureur revenant de son travail, les membres las et l'âme pensive, porté par un des chevaux qu'il a guidé tout le jour à travers les guérets et qui rentrant au logis, assure d'abord le repas et le repos de ses bêtes avant de s'asseoir devant une jatte de soupe fumante, sa maigre pitance. Ensuite avant de s'abandonner au sommeil, il songe mélancoliquement à l'année qui se termine. Si le blé s'est vendu trois fois plus cher, par contre les instruments aratoires et les engrais ont vu leurs prix quintupler. Mais la terre est plus qu'une manufacture, elle est une fiancée.. et les doux rêves versent leur baume au coeur du laboureur.

A côte de ces laboureurs que l'on voit tenaces aux mancherons de lourdes charrues et traçant droits et profonds leurs sillons, il y a les toucheurs de boeufs, dont l'habilité ne se dément jamais une minute. Armés d'une gaule terminée par un aiguillon, ils conduisent facilement un attelage composé de deux ou trois paires de boeufs. Ils ont *la touche juste*, et l'aiguillon entre leurs mains habiles est un instrument délicat qui assurent l'effort concerté et la docilité la plus parfaite de l'attelage.

Rien n'est plus imposant que ce spectacle et rien ne témoigne plus éloquemment de l'habilité des remueurs de la glèbe et du long et patient labeur que requiert la terre pour engendrer l'épi qui va soutenir l'humanité.

La chanson du labour est presque "l'obligato" des faiseurs de sillons: ces chants qui semblent destinés à encourager le laboureur, pénètrent jusqu'à âme des boeufs pour stimuler leur ardeur. En Bresse on chante.

Le pauvre laboureur
Il est bien malheureux.
Du jour de sa naissance,
Il a bien du malheur:
Qu'il pleuv', qu'il neig', qu'il grêle,
Qu'il fasse mauvais temps,
L'on voit toujours sans cesse
Le laboureur aux champs.

Au dernier couplet, sur un ton plus élevé, il chante avec fierté:

Il n'y a roi ni prince,
Ni ducque ni soigneur,
Qui n'vive de la peine,
Du pauvre laboureur.

Paul Arène qui a recueilli lui-même une chanson provençalle du même genre nous dit:

"C'est, la plainte du paysan, l'histoire ingénuement contée de son éternelle querelle avec la terre. Et certes, un paysan seul a pu, dans l'ennui des lents labourages, composer lentement, sur une musique large, triste et se prolongeant en échos, ces couplets d'un réalisme si poignant et si mélancolique".

Venez pour écouter—
La chanson tant aimable
De ces pauvres bouviers
Qui passent leur journée
Aux champs, tout en labourant.

Quand vient l'aube du jour,
Que le bouvier s'éveille
Il se lève et prie Dieu;
Et puis après il mange
Sa bouillie de pois
C'en est la saison.

Prépares-moi du blé pour les semailles
Quand viendra l'heure du goûter,
Apporte-moi le flacon.
Puis tu racommoderas mes culottes
Je crois bien qu'avant-hier
Labourant à la lisière,
Un buisson m'en a pris le fond.

Un des aspects surprenant de la vie des boeufs, c'est l'attachement mutuel de chaque compagnon de joug "Ceux que ne connaissent pas la campagne dit Georges Sand (Mare au Diable) taxent de fable l'amitié du boeuf pour son camarade d'attelage. Qu'ils viennent voir au fond de l'étable un pauvre animal maigre exténué, battant de sa queue inquiète ses flancs décharnés, soufflant avec effroi et dédain sur la nourriture qu'on lui présente les yeux toujours tournés vers la porte et grattant du pied la place vide à ses cotés, flairant les jougs et les chaines que son compagnon a portés et l'appelant sans cesse avec de déplorables mugissements. Le bouvier dira: "C'est une paire de boeufs perdue; son frère est mort, et celui-là ne travaillera plus. Il faudrait pouvoir l'engraisser pour l'abattre; mais il ne veut pas manger et bientôt il sera mort de fain."

Les scènes de labour varient à l'infini suivant l'importance des fermes et la nature du terrain; mais que ce soient les jeunes ou les vieux qui participent à ce travail, que ce soient les tracteurs, les chevaux, les boeufs les vaches ou les mules qui tirent la charrue toujours l'effort patient et l'habilité du laboureur méritent notre admiration. Lamartine avait raison de s'écrier:

"Pour rendre la glèbe féconde
De *sueurs* il faut l'amolir"

Pour se faire une juste idée du labeur des terriens français, il faut songer aux dimensions réduites des fermes qui ne permettent pas toujours l'application du machinisme moderne. Encore une fois n'oublions pas qu'il y a plus de 4,500,000 de ferme dont l'étendue varie entre 24 acres et moins d'un acre.

A ceux qui seraient tentés de juger la situation d'une façon superficielle par les quelques scènes rurales dont ils ont été témoin en parcourant les routes de France, je dirais, comme je l'ai déjà dit, que pour apprécier une methode de culture, il faut d'abord apprécier le milieu où cette méthode est appliquée. Vous attendriez-vous de trouver des tracteurs et des moissonneuses lieuses et des batteuses de grandes dimensions sur des fermes de 3, 5, 10 ou 20 acres? Avant de faire le tableau des activités paysanne, il faut songer au cadre dans lequel ces activités s'exercent. C'est donc pour ces raisons que les instruments de culture comme la faucille, le van et le fléau, qui, chez-nous, fraternisent sous la poussière des greniers avec les rouets et les crénolines de nos grand'mères ont encore beaucoup d'actualité en France.

"Deux *jolis objects*, le fléau et la van d'osier—deux beaux gestes: celui du batteur et du vanneur que la machine fera disparaître plus tard ici comme ailleurs!"

Les économistes ont l'espoir que les paysans, convaincus des avantages de la coopération, s'uniront un jour pour l'achat et l'usage en commun des machines agricoles perfectionées qu'ils ne peuvent rationnellement posséder seuls. C'est le grand problème de l'avenir et déjà on s'achemine vers cette solution en menaçant de chasser des champs la poésie qui se dégage des opérations culturales accomplies d'après le rite primitif.

Qu'il est quand même beau, quoi qu'en disent les économistes avec qui ma profession me force à me ranger, qu'il est quand même beau, dis-je, ce spectacle d'armées de faucheurs s'avançant par files régulières à travers les hautes herbes de la prairie pendant qu'au loin apparait la fermière avec son âne portant des paniers de nourriture et un tonnelet de bière!

La faux française a gardé sa forme primitive. Malgré que son manche anguleux et ses poignées sans élégance et sa large lame grossière n'aient rien de comparable à l'élégance la légèreté et la qualité de la faux canadienne, elle subsiste quand même active aux mains des paysans français conservateurs et peu portés aux innovations.

Dans les pays de petite culture le fenaison a conservé son cachet de poésie ancienne; la cadence monotone des coups de faux faisant tomber le foin en "ondains" se compare avantageusement au terrible bruit de mitrailleuse des faucheuses mécaniques.

Après les faucheurs ce sont les faneuses qui avec des gestes pleins de grâce secouent et retournent les "ondains" en emplissant l'air des parfums des herbes mortes comme des notes douces de leurs voix fraiches.

Le coté agréable de ce travail n'avait pas échappé à l'observation de Madame Sévigné qui disait que "faner, c'est retourner du foin en batifolant dans une prairie".

Cependant ceux qui songent que ce travail s'accomplit sous l'ardeur d'un soleil de juillet voient une autre coté à la médaille poétique!

Pour terminer l'opération le foin est mis en "movettes" "toutines" "cabotins" "capucins" c'est-à-dire en petits amas de forme conique qui sont des veillotes que votre parler populaire a qualifié de "veilloches".

La rentrée des foins et des grains, l'arrachage des betteraves, des pommes de terre et du lin, le binage et le sulfatage de la vigne etc.,. . . . . sont autant d'opérations culturales qui réquièrent d'une façon constante l'application des muscles et de l'intelligence du terrien français. Il faut voir les paysans à l'oeuvre, sur les guerets comme sur les chaumes et les prairies, depuis l'aube jusqu'au couchant, pour juger de leurs patients labeurs!

Je vois encore, là-bas, au sommet du côteau le pâtre debout et sifflant ses chiens pour les inviter a partager son repas, sous l'oeil bénévole d'un troupeau de quelques centaines de moutons bien dociles. Je le vois entr'ouvrir sa panetière pour en retirer un morceau de viande, un chanteau de pain, et un gobelet d'étain pour recevoir l'eau de la source. La vie de ces bergers isolés au milieu de leur troupeau et exposés à toutes les intempéries, sans autre abri souvent qu'une misérable petite hutte, m'a semblée une vie très rude. Aussi les bons bergers et les bonnes bergères deviennent de plus en plus rares.

A la campagne les chômages sont rares, et comme la ferme est apte à procurer du travail à tout le monde, nous voyons souvent des garçons et des fillettes qui gardent de petits troupeaux de vaches, de chèvres, de brebis ou d'oies le long des grandes routes, sur les coteaux ou au fond des ravins.

En pays de montagne comme dans les Vosges, la Savoie ou l'Auvergne ce spectacle revet un caractère de simplicité des plus admirables.

Combien de jeunes paysannes qui se distraient de la surveillance de leur troupeau en tricotant; combien de vieilles femmes également qui tricottent de leurs vieux doigts tremblants près d'une vache docile. L'animal rase avec avidité l'herbe du pré en attendant l'heure de la traite ou l'heure pénible, où l'on devra l'atteler pour les rudes besognes de la ferme.

"Dans bien des villages, comme Antony Valabrègue (Sur les Grandes Routes de France) j'ai rencontré des femmes très usées en apparence et dont ne saurait dire l'âge.

"Elles ont la physionomie ascétique, le dos par habitude, comme si elles venaient de se pencher sur la tâche, ou bien elles se tiennent assises sur un banc, absorbées dans une contemplation immuable —— elles semblent une apparition résistante et tenace du passé.

"Elles ont la physionomic ascétique, le visage osseux et transparent, le teint exsangue et couleur de cire. La maigreur a fait ses doigts effilés, et elles tiennent leurs mains tombantes. On se doute, à les voir, qu'elles occupent peu de place au logis; elles se font petites, se blottissent dans les coins pour se faire oublier, et se pelotonnent sur le seuil ou près du feu."

"On les prendrait presque toutes, au premier abord, pour des centenaires; mais aux champs, les traits sont vite flétris, et quand on les examine de près, quelque détail de leur visage semble indiquer qu'elles n'ont peut-être pas dépassé la soixantaine. Il y a des vieilles qui sont proprettes. . . .des yeux clairs et vigilants. Un bonnet tuyauté couvre leur tête, et l'on ne devine pas qu'elles n'ont plus de cheveux. On rencontre des vieilles en haillons acceptant le charité des voisins, glanant dans les champs après la moisson."

La participation des femmes aux travaux des champs est un des traits de la culture française qui retient le plus l'attention du voyageur canadien. Au moment de l'arrachage des pommes de terre, des légumes ou du lin comme au temps des vendanges et des récoltes, toute la famille est mobilisée aux champs.

Et dans les provinces, comme l'Alsace, où la population est groupée, vous ne trouvez que des invalides aux maisons, et pas être qui remue au village. Toute la population est éparpillée aux champs. La femme accompagne généralement son mari aux champs pour soutenir son ardeur comme elle l'accompagne à la foire le protéger contre ses faiblesses...... surtout quand les ventes ont été heureuses et que le vin nouveau a fait son apparition.

L'on ne pourrait faire le bilan des activités de la femme rurale sans signaler la profonde modification qui s'opère dans les campagnes par suite de la disparition graduelle des petites industries domestiques.

Déjà en 1856 cela faisait dire à Bonnemère (Histoire des Paysans p. 372-73) que "l'industrie des femmes est détruite .... le fuseau tourne stérilement entre des doigts découragés. La ville a enlevé aux champs cette précieuse ressource; c'est vers la ville que le paysan tourne ses regards pour suivre de ses regrets cette richesse enfuie à jamais, pour contempler ces puissantes machines qui ont brisé, sous le premier tour de leurs roues, les quenouilles de toutes les paysannes.

"Avec l'industrie des fileuses ont disparu les veillées, ces joyeuses réunions des longues soirées d'hiver. Là s'entretenaient l'esprit de société, la gaieté, l'amitié; là aussi l'amour pur et naif naissait et se développait librement et franchement sous l'oeil de la mère et à la face de tous.

"Les légendes terribles, les chansons aux couplets sans nombre, faisaient oublier la marche du temps. On se voyait plus souvent et de plus près, et l'on s'aimait.

"Aujourd'hui ces réunions qui n'ont plus de prétexte ont disparu. Chacun est enfermé chez soi; au lieu de causer avec son voisin, *on cause de son voisin* et, faute de se voir, on s'aime moins.

"C'était, en effet, le bonheur des champs que filait la quenouille des fileuses; c'est le bonheur des champs que les machines ont broyé sous leurs dents de fer."

La même plainte de nostalagie du passé est sortie du coeur du grand remancier de la France rurale, M. René Bazin (Le Moindre Effort).

"Dans ma jeunesse, tous les quinze jours, la métayère, sa fille, ou son fils boulangeaient dès la première heure, puis le four était chauffé avec des brassées d'épines (Il n'y avait donc pas de pain sans épines, pourrai-je dire) et bientôt dans la campagne, la cheminée versait à la fois un peu de fumée bleue et l'abondante odeur de pain frais, un grand parfum qui courait sur les sillons mêmes où le blé avait mûri. Aujourd'hui, elles sont rares les fermes où l'on trouve dans la grande salle commune, la panetière ou l'échelle horizontale pendue au plafond, ou encore la large planche accrochée à la muraille, où reposent alignés les lourds pains ronds que la ménagère appuiera contre sa poitrine et coupera en moellons qui résistent à la dent, mais qui résistent aussi dans le sang des hommes......"

Il ne faudrait, cependant, pas conclure trop hativement que le pain de ménage n'existe plus en France parce qu'il m'a été donné assez souvent d'assister à des cuites de pain dans quelques fermes des environs de Limoges, au coeur du Limousin.

Quoiqu'il en soit de ces transformations de la vie rurale modifiée par l'introduction du mécanisme moderne et des idées urbaines répandues par la presse, le service militaire et le flot des touristes, il n'en reste pas moins vrai qu'il y a une France paysanne encore très active qui n'a pas été plus avare de son sang sur les champs de bataille que de ses sueurs sur les champs de culture, et qui continue aujourd'hui d'assurer le relèvement du pays par l'or qu'elle extrait des sillons comme par l'inertie qu'elle oppose aux mouvements révolutionnaires.

Paul Harel avait bien raison de s'écrier:

"Ah que le déserteur s'arrête et revienne
Vers la ferme, à l'endroit où ses pères sont morts
Du métier désappris, que l'absent se souvienne
C'est le travail des champs qui rend les peuples
forts."

Concerning the C.S.T.A.

APPLICATIONS FOR MEMBERSHIP

Bégin, L. (Laval, 1923, B.S.A.), Ste. Anne de la Pocatière, P.Q.

Mackay, J. W. (Toronto, 1922, B.S.A.), Ottawa, Ont.

Wahlen, F. T. (Zurich, 1919, B.S.A.), Ottawa, Ont.

White, A. H. (Toronto, 1917, B.S.A.), Ottawa, Ont.

ERRATUM

In our last issue we stated that W. D. Jackson, (O.A.C. '09) had been appointed Secretary and Manager of the Guelph Winter Fair. This should have read "Western Fair, London, Ont."

NOTES

C. J. Lynde (Toronto, 1895, B.A.; Chicago, 1905, Ph.D.), who has been Professor of Physics at Macdonald College since 1907, has been appointed Professor of Physics in the School of Practical Arts, Teachers College, Columbia University, New York City. He will assume his new duties on July 1st, 1924.

James Laughland (O.A.C. '10) has been appointed Agricultural Representative for Lennox and Addington Counties, Ontario, with headquarters at Napanee. He succeeds C. C. Main (O.A.C. '11) who has been transferred from Napanee to Cayuga, as Agricultural Representative in Haldimand County.

J. A. Steele (O.A.C. '20), who has been with the Soldier Settlement Board at Chinook, Alberta, is taking graduate work in agricultural economics at Iowa State College. His address is 307 Lynn St., Ames, Iowa.

L. H. Hanlan (O.A.C. '22), Asst. Superintendent of the Dominion Experimental Station at Kapuskasing, Ont., has been awarded the Wm. C. Macdonald, Regd., Scholarship (Ontario) for 1924.

THE ANNUAL CONVENTION

The final programme of the C.S.T.A. Annual Convention will be embodied in the O.A.C. Semi-Centennial Programme, which will be mailed to all O.A.C. alumni early in May. The C.S.T.A. programme will also be sent from Ottawa to all members of the Society at about the same time.

Advanced Lectures

The following have already accepted invitations to give lectures at the C.S.T.A. Convention:

Horticulture—Dr. E. J. Kraus, Professor of Botany at the University of Wisconsin (2 lectures).

Mr. Arthur Kelsall, Annapolis Royal, N.S., in charge of Insecticide Investigations under the Dominion Entomological Branch (2 lectures).

Two lectures are also being arranged on Fruit Insects.

Agronomy: The following will each give one lecture:

Dr. W. L. Burlison, Chief, Dept. of Agronomy, College of Agriculture, Urbana, Ill.

Dr. G. P. McRostie, Dominion Agrostologist Ottawa.

Dr. J. W. McArthur, Ontario Agricultural College, Guelph, Ont.

Mr. E. S. Hopkins, Dominion Field Husbandman, Ottawa.

Mr. W. P. Fraser, Dominion Laboratory of Plant Pathology, Saskatoon, Sask.

Dr. H. H. Love, Cornell University, Ithaca, N.Y.

Economics: Dr. B. H. Hibbard, Professor of Economics at the University of Wisconsin (2 lectures).

Dr. H. Michell, Professor of Economics, McMaster University.

Mr. J. S. McLean, Manager of the Harris Abattoir Co., Toronto.

R. D. Colquette, Professor of Marketing Economics, Ontario Agricultural College.

A. Leitch, Professor of Agricultural Economics at the Ontario Agricultural College.

ANIMAL HUSBANDRY: Dr. R. L. Conklin, Veterinarian, Macdonald College.

Dr. J. W. Gowen, Biologist, Agricultural Experiment Station, Orono, Maine, (2 lectures).

Dr. C. F. Huffman, esearch Assistant in Dairying, Michigan Agricultural College, East Lansing, Mich. (2 lectures).

Dr. W. Lash Miller, Professor of Chemistry, University of Toronto.

The four courses of lectures will be held concurrently during the mornings of June 12th and 13th, three lectures being given in each course each morning.

Business Meetings

The business meetings will occupy the mornings of June 10th and 11th and the evening of June 11th. The evening meeting will be devoted to the Presidential address by Prof. H. Barton and to the annual report of the General Secretary. It is considered important that these should be followed by a discussion period, and the convention will therefore not formally adjourn until the close of the evening meeting.

The reports of committees on Marketing, Education (A. Leitch), Research (J. F. Snell) and Graduate Study (G. G. Moe) will be read on the morning of June 10th and of the Committee on Educational Policies (L. S. Klinck) on the morning of June 11th.

As there will be an unusually large amount of important business to transact, it is possible that an extra session will have to be arranged for, but in view of the many attractions offered by the O.A.C. semi-centennial celebrations, it is hoped that the business of the C.S.T.A. can be completed in the time now being assigned for that purpose.

The week of June 9th, at the O.A.C., offe to professional workers in Canadian agi culture an exceptional opportunity of mee ing one another. The probable attendan has been estimated at from six to twel hundred. Time, energy and money are bein spent to make the week a memorable one, an the best acknowledgement we can give those in charge of arrangements is—to there!

ELECTION RESULTS

The following are the results of the Don inion elections conducted by mail during th month of April:—

President—H. Barton, Macdonald Colleg P.Q. (Re-elected).

Vice-Presidents—G. C. Creelman, Beam ville, Ont.; Rev. Father Leopold, La Trapp P.Q.

Hon. Secretary—L. H. Newman, Ottaw Ont. (Re-elected).

The ballots were opened on May 1st b Mr. L. H. Newman of the Dominion Execu tive, the General Secretary, and a third part not connected with the Society. This is i accordance with the by-laws.

472 members voted.

H. BARTON

Re-elected President of the C.S.T.A.